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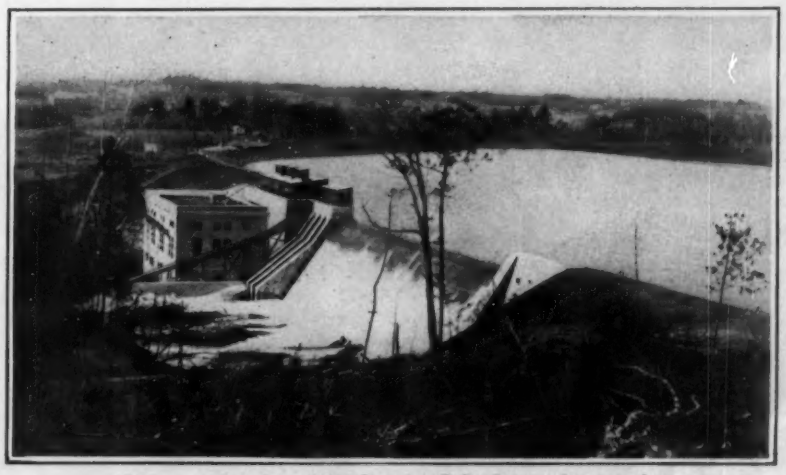
Dam and power-house of a large paper manufacturer at Dundee Falls, near Portland, Me., which generates electric current yielding 4500 horse-power

The Neglected Water Power of New England

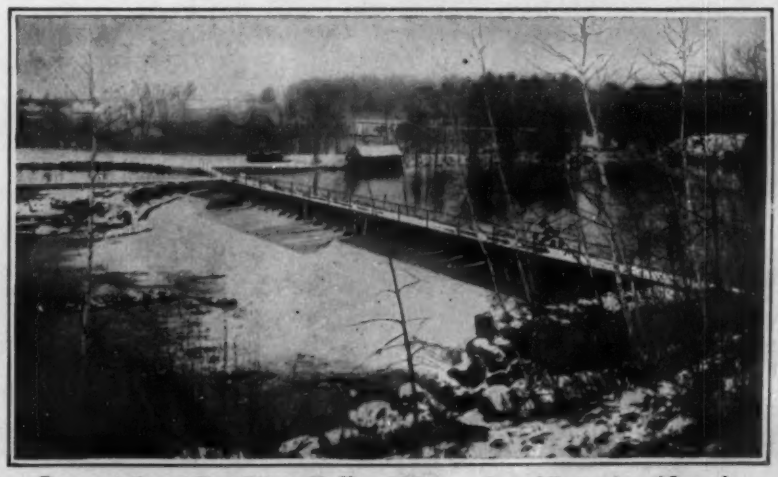
IN our great West we have been busily engaged in developing water power in units of incredible magnitude. We are just awaking to the fact that in another and older section of the country we have water power possibilities worthy of our closest attention. New England's streams are for the most part of comparatively small caliber; but they all run down hill, they are unusually constant in their year-round flow, and in their aggregate they present a most attractive field for the hydro-electric engineer.

Slowly but surely New England is coming to realize the vital importance of developing this resource. That this vast reservoir of power should have been so long neglected is little short of amazing. In Maine alone, water tumbles down to the ocean from no less than 2,200 lakes and ponds. A southern pine land owner, whose holdings would dwarf a German principality, was looking up a quiet reach of the Pemigewasset River in New Hampshire the other day. "Have you ever investigated the possibility of a dam right here?" he inquired; "I shouldn't be here a week before I had done so. I have engineers working on a river in Mississippi and Alabama right now, which anybody could see does not offer nearly so good a chance as this one."

The chief engineer of the Maine Water Storage Commission has long had a pet theory that his State's water power, rather than her lumber, should be accorded first place among the natural assets of Maine. He finds that from 1905 to 1911, inclusive, the lumbering operations resulted in an annual average of one billion feet, board measure, valued at $16,500,000. He finds



More general view of the Dundee Falls dam and reservoir



Power station at East Tilton, N. H., which runs the public service of Laconia

that the total power developed by some twelve hundred plants on the rivers and streams of the State is now about 376,000 horse-power. The annual value of a single horse-power has only to be set at $44 to make the small fraction of Maine's water power that is now developed worth as much as the output of all her forests.

But that is only the beginning. Though the State now ranks third in the Union in the amount of water power developed, and second in the amount used for manufacturing purposes, New York alone leading it in this respect, it has only made a start in such development. The Kennebec alone is capable of producing almost as much water power as the whole State now yields; yet with all its tributaries it drains only one-fifth of the State's area. At the present time attention is being given the problem of increasing the storage basins, so that less of the water will run off to waste during the seasons of spring freshets; and it is stated that the existing reservoir storage of two hundred billion cubic feet can easily be doubled.

Such projects as the Keokuk and Prairie du Sac dams in the West are located where there is less natural fall than is found at dozens of points on the rivers of New Hampshire. Of course those dams impound the flow of mighty rivers, the Mississippi and the Wisconsin; but many of the Granite State rivers would repay exploitation proportionately as well as those of the Middle West. New Hampshire's unutilized water power is still exceedingly large. A decided fall of water, even, is not necessary for the establishment of water power seats. Some of the best will yet be located in New Hampshire under conditions which reproduce those of the Keokuk installation. The late Edward

(Concluded on page 154)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Trench Mortality

READERS whose relatives and friends have been called in the draft should get considerable comfort from a study of the mortality statistics of the European armies recently put forward by a well known Boston statistician. While his figures are not so favorable as those given out from Paris indicating that all kinds of permanent losses—killed, captured, missing and disabled—aggregate but three per cent per annum of the effective forces engaged, they are nevertheless distinctly encouraging. He finds that about sixty men per thousand are being killed, and 150 wounded, and that a very large proportion of the latter return to the trenches. This, naturally, is not to be compared with the normal death rate, in time of peace, of men of military age, which is but eight per thousand; but it is immeasurably better than our amateur and professional pessimists would have us believe, and a vast improvement upon the showing of any previous war.

For one thing, disease has been so thoroughly eliminated that a sick man is a curiosity. The soldier at the front is certainly less liable to attack than if he were at home. Everything he eats and drinks and wears, almost everything he touches, is subject to the finest medical supervision of which science is capable; and if any particularly persistent bacillus were to get into his system in spite of all precautions, it would find him in such superb condition that its work would be futile. The high commands have thoroughly learned the lesson that it does not pay to train a man to be a soldier and then lose him from a cause that is in the least degree preventable. By this same token, experience, both in the protection of the soldier and in the care of the wounded, is steadily reducing the death rate as the war progresses. Not only are new tactics constantly being developed which result in less exposure of the individual soldier, but he is constantly being better equipped with defensive apparatus to minimize the effects of bullet or shrapnel or gas attack. Finally, from many classes of wounds which would have spelled probable death in 1914 and certain crippling in 1915, recovery, thanks to Carrel and others, is now almost a matter of course.

Of course, the mortality varies with the work done. It is asserted, and we have seen no authoritative denial, that the death rate among the petty officers, from lieutenant down, is high. On the other hand, a man connected with the heavy field artillery is just about as safe as though he were doing railroad work at home. And so it goes. On the whole, it seems clear that there is not the slightest justification for the cries of the busy calamity howlers that "the boys who go to France will never return." The drafted man who goes as an ordinary soldier, taking his judgment with him and leaving his excessive enthusiasm behind, has every chance of coming back, and in better physical condition than when he left.

Brands From the Burning

IN a recent issue we called attention to a few avenues of war-time conservation which have not been explored to their entire length, and tried to emphasize the necessity for effort in the di ections thus indicated. One item which we mentioned briefly was the fire loss as it directly affects the food supply. We wish now to dwell a bit more fully upon this.

The aggregate fire loss in the United States reaches an appalling total. For 1915 it was $172,000,000; or 1916, $215,000,000. That such waste has been permitted can only be taken to mean that, as a nation, we find that adequate protection and prevention would cost more, in time, in money, and above all in effort, than the fires to which we lay ourselves open. Reprehensible at all times, this point of view becomes a wholly impossible one when it involves the destruction, at the present time, of quantities of food.

Such destruction carries with it far more than mere financial loss. Every pound of food lost now means a pound less for the world's collective stomach next winter. We cannot eat food that we have burned up. Therefore if we want to eat we must prevent the fires that claim such a large share of the country's food product.

In the first place, let it be clearly understood that in sounding a note of alarm on this score we are not baying the moon. Of Ohio's fires for March, 1917, 16 per cent were clearly identifiable as affecting food supplies, and these caused 30 per cent of the state's loss for the month. Two of these, one involving a grain elevator and the other a grain and feed store, were of sufficient magnitude to account for 14 per cent of the $473,000 which Ohio burned up in March. For May the fires in the same state affecting food products constituted 27 per cent of the total in numbers, and 24 per cent in loss. One small-town conflagration destroyed two elevators and four hay-filled barns, for an aggregate loss of $27,000.

A slightly different angle is had in the *Journal of Commerce* reports of all fires throughout the country in which the damage exceeded $10,000. For the three months of May, June and July there are recorded 11 mill fires with losses of $355,000; 15 elevator fires, with losses of $2,411,000; 35 fires in food warehouses and packing plants, with losses of $2,001,000; and 4 bakery fires, with losses of $119,000. For the entire quarter we have here 65 of these major fires, with losses aggregating $4,886,000. When it is remembered that these figures are exclusive of groceries, which figure largely in the burning record, of grain in the field, of which much is always thus destroyed, and of farm losses (grain in barns, feed, livestock), which it is impossible to compute; when it is further recalled that they avoid all speculation as to the stores of food consumed in residence fires, which constitute 70 per cent of the total and cause a third of the loss; when it is finally pointed out that they omit all reference to hotel and restaurant and apartment house fires—when all these things are taken into consideration, it must be plain to the most confirmed fire optimist that we have here a destruction of our food stocks which cannot be tolerated in this year of extraordinary demands.

To be sure, it cannot be prevented in toto and all at once. But it can be greatly reduced without the slightest difficulty. Producers and handlers of food products, as a class, have few close rivals when it comes to ignoring the two dominant factors of fire control—prevention and protection. Many of the buildings that house these industries are veritable fire traps, utterly unfitted for the business carried on in them; and even in these, rubbish is allowed to accumulate, electric wiring is defective, exposed, or wholly unprotected, dust covers everything, awaiting only a spark to precipitate disaster, protective equipment is generally lacking, and such as exists is neglected until it deteriorates and becomes ineffective. On top of all this, adequate watch is rarely maintained—an absolute essential where the dangers from spontaneous combustion and other unexpected outbreak is so great as it is in many of these establishments.

Eternal vigilance is the price of safety from fire. Constant inspection and re-inspection of a plant, to maintain order and cleanly conditions, is the first essential, regardless of structural soundness and safeguards. Training of the employees in a fire drill is necessary, not merely that they may escape in orderly fashion in event of fire, but to discipline them in vigilance against fire and to fight fire in case it develops. An adequate private system of fire alarm and fire protection is a prime requisite. The fire department may be fighting a big fire a mile or miles away when the time of need comes. Just such a contingency as that would offer a splendid opportunity for the criminal activities of the firebug. If there is not, in this eventuality, an adequate private system of protection, the plant is doomed—and with it the stores of food products it contains.

Nor should the fact that insurance companies grant credit in the fire insurance premium rate be permitted to exercise the dominant influence, in either the installation of protective equipment or its maintenance or abandonment after it is installed. The savings in the cost of indemnity thus made possible are desirable, and to the extent that they influence the yearly cost of doing business are important; but to burn is more expensive than to protect and to insure, and insurance received on a policy will not restore the plant or provide food in place of that destroyed, for either the men on the fighting line or their dependents at home. The insurance credit should be an incidental saving, never an end in itself.

The folly of a penny-wise, pound-foolish policy in this respect was strikingly exemplified recently in the burning of an elevator in New York State. Up to four years ago the elevator was sprinkled; with an antiquated system, to be sure, but much better than none. About four years ago the insurance companies withdrew the credit in the rate theretofore granted and the elevator concern thereupon tore out the sprinklers. A few weeks ago the plant burned, with losses (buildings and contents) aggregating nearly $700,000. And the chief of the fire department declared that if the sprinklers had been left the plant would have been saved.

The subject of fire prevention can be summarized in no better way than by quoting the words of President Wilson, addressed to one of the national bodies interested in the matter. The President wrote as follows:

"Preventable fire is more than a private misfortune. It is a public dereliction. At a time like this of emergency and of manifest necessity for the conservation of national resources, it is more than ever a matter of deep and pressing consequence that every means should be taken to prevent this evil."

This, of course, applies to fires in all fields; but under existing circumstances fires that destroy foodstuffs are just a little bit more unfortunate than any other kind of conflagrations. Accordingly, every one of us who has to do with the preparation, handling or storage of edibles should recognize it as a patriotic duty to display extraordinary vigilance in the matter of fire prevention.

The Smith-Hughes Act for Vocational Education

THANKS to the engrossing interest of war topics comparatively few people outside of educational circles have had their attention directed to the fact that the United States has just embarked, for the first time in its history, upon a national scheme of state-aided vocational education. Under the terms of the Smith-Hughes Act, passed last February, the legislatures of several states have already decided to accept the coöperation of the Government in this class of education, while other states will undoubtedly fall in line in the near future.

This act is quite similar in some of its features to the Agricultural Extension Act of 1914. There is the same provision for continuing and increasing appropriations, beginning with $1,700,000 in 1917, and rising to $7,200,000 in 1925. The available money will be distributed among all states which agree to contribute sums equal to their allotments and to conform to the terms of the act. The appropriation provides for the creation of three distinct funds, viz., (1) for paying salaries of teachers, supervisors or directors of agricultural subjects; (2) for paying the salaries of teachers of trade, home economics and industrial subjects; and (3) for training the teachers and others mentioned under (1) and (2). The basis of distribution among the states is rural population under (1), urban population under (2), and total population under (3). A state may accept benefits under one or more of these funds, as it prefers.

The act creates a Federal Board for Vocational Education, consisting of the Secretaries of Agriculture, Commerce and Labor, the United States Commissioner of Education, and three other members, to be appointed by the President, of whom one is to represent manufacturing and commercial interests, one agricultural interests, and one labor interests. The board, besides administering the act and supervising the work in the several states, will carry out investigations of various kinds relating to vocational education, coöperating, so far as may be advisable, with the Department of Agriculture, the Department of Commerce and the Bureau of Education.

The principle of vocational training on a general scale, although well established in some parts of Europe, has met with a formidable amount of opposition in this country. The curious anomaly has existed that the same communities which supported out of public funds the professional schools attached to state universities, the normal schools for the training of teachers, and commercial high schools for fitting boys for business, were loth to offer analogous training to manual workers. The change of sentiment betokened by the passage of the Smith-Hughes Act is presumably a part of the general awakening of interest in "efficiency" and "preparedness" which has recently been witnessed in our country, and which goes so far toward compensating us for the present and prospective evils of the world war. Thus it is not so strange as it might appear to be at first sight that a radical step of this kind should have been taken by the Government at a time when its attention was focussed upon preparations for warfare rather than civic betterment. It will be recalled that another momentous educational undertaking, the establishment of the land-grant colleges for higher education in agriculture and the mechanic arts, under the Morrill Act, was inaugurated in the midst of the Civil War.

There has been a fear in some quarters that the spread of vocational training would disturb the principle of compulsory general education, but this is not the case. Every boy and girl will be required to get the same minimum amount of "book learning" as at present, but those who, under conditions now prevailing, would enter the trades and industries as unskilled laborers will, in the new era, receive specialized training that will enable them to command higher wages and make them vastly more useful members of society. They will be no more committed to a lifetime of manual labor than they are now. Indeed it is an easier step from the position of a skilled laborer to a career in business or the professions than from that of an unskilled laborer.

Electricity

The Purple Color of Lamp Globes.—The presence of the often noted purplish tint of lamp globes, states the *General Electric Review*, has been shown to be due to manganese. This journal continues by calling attention to the fact that the introduction of manganese to neutralize the greenish tint due to slight quantities of iron oxide, may reduce the light transmission factor from 10 to 25 and even 55 per cent, there having been found specimens having 85 per cent reduction. The recommendation is therefore made that in outdoor illumination glassware the manganese be omitted from the formula.

The Electric Fan and Food Conservation.—From a warm weather instrument primarily, the electric fan appears to be applicable to the problem of the hour—the conservation of our food. The United States Department of Agriculture has recently suggested the use of the conventional electric fan for drying vegetables. In a recently-issued bulletin on the subject it states that tests have proved that many sliced vegetables and fruits placed in long trays three feet by one foot and stacked in two tiers end to end before an electric fan can be dried to the requisite dryness within 24 hours. Some vegetables require even less time.

Electric Sirens as Air Raid Warnings.—In England many of the large manufacturing establishments employing numerous hands make use of electric sirens for warning employees in the event of air raids. The sirens are designed for use in connection with interior calling or alarm systems and to supersede bells, gongs and other signalling methods. They are capable of operation on regular lighting circuits, and require little amperage. These sirens are instantly responsive to either button or self-operating mechanism, and may be wired in series or parallel as desired. Code signalling can be readily obtained with these horns, which, owing to their distinctive tone, command instant attention.

Induction Apparatus for Locating Projectiles in Human Bodies.—An article describing a device for discovering foreign substances of a magnetic nature in the bodies of the wounded, which differs both from the electro-vibrator and the electromagnetic balance, appears in a recent issue of the *Revue Generale de l'Electricité*. With the electromagnet the projectile is discovered by the touch, and with the induction balance by means of the telephone. The apparatus here described utilizes a galvanometer to detect the presence of a bullet or other magnetic substance, and makes it possible to discover the depth to which it has penetrated. The chief distinguishing characteristic of the apparatus is the employment of a galena detector to rectify the induced currents.

An Alternating-Current Telegraph Sounder.—In a recent issue of the *Electrical Age* there appears a description of a newly-introduced telegraph sounder that operates on alternating current. It is similar in appearance and construction to the conventional telegraph sounder, the only marked difference being in the position and construction of the magnet spools and armature. The magnet spools have their cores extending toward each other, and the armature is abbreviated so as to move between the core extensions without touching them. For best results the armature lever should have more than the ordinary play between stops. The stop-screw for attraction stroke is set so that on closing the circuit, momentum carries the armature and its lever beyond the point of greatest magnetic density, where it strikes the stop, from which it instantly rebounds and is held floating noiselessly in the magnetic field until the circuit is broken, when the tension spring forces it to the opposite stop as in usual practice. The sounder can be used on any 110-volt 60-cycle circuit, either in series with a lamp or through the secondary of small, inexpensive transformer.

What About Our Insulators?—During the last few years, says the Committee on Transmission and Distribution of the A. I. E. E., the trouble with high-tension insulators has become cumulative. During the summer season of 1915 and 1916, the failure of insulators on some long-distance transmission lines resulted so disastrously in the way of interruptions that it was evident something had to be done unless we were content to relegate long-distance service to the category of intermittent or second-class power. Some of our best engineers are working on the problem. A number of the far western companies had clubbed together and employed the best talent they could find to carry on the investigation. Professor Ryan of Leland Stanford University is now busy carrying out experiments on a very large scale to determine the effects of porosity in porcelain. All who are acquainted with Professor Ryan and his work know that his results when published will carry authority on this point. So far as porcelain insulators are concerned we know (1) that porosity must be reduced to the lowest practical limit to prevent absorption, (2) that joints must be so designed and made that the insulators will not crack from expansion and contraction effects, (3) that insulators must have ample margin of mechanical strength.

Science

"Abstracts of Bacteriology."—Under this title a new bi-monthly abstract journal has been established by the Society of American Bacteriologists, with a numerous corps of abstract editors and abstractors. In the initial number will be found, besides the abstract material and reviews, an account of the proceedings of the annual meeting of the society, held last December.

The Bureau of Economical Geology of the University of Texas has just issued a report on the Thrall Oil Field. This field was discovered three years ago, in Williamson County, and it proves to be unique for the United States, the greater part of the production coming from a metamorphic chlorite derived from an extremely basic igneous rock. This rock apparently represents a submarine eruption in the Cretaceous sea. Copies of the report, which covers 93 octavo pages, and contains seven plates and seven figures, can be obtained from the Bureau of Economic Geology, University of Texas, Austin, Texas.

The Force of an Avalanche Wind is illustrated in a case recently reported by Mr. M. B. Summers, in charge of the Weather Bureau station at Juneau, Alaska. The wind occurred as the result of a heavy snowslide into Gold Creek Gulch, near Juneau. This gulch is at the foot of the precipitous south slope of Mount Juneau. On the opposite side of the gulch, at a distance of 150 feet from the bank where the slide occurred, stood three cabins. The force of the blast generated by the down-rushing snow was sufficient to demolish these cabins completely and to carry the débris 100 feet up the slope. The wind also rushed laterally along the gulch, destroying another cabin 500 feet distant. In the town of Juneau, a quarter of a mile distant, the force of the wind was felt strongly, and the town was enveloped in a blinding whirl of snow for several minutes.

Protection of American Wild Flowers.—For the past fifteen years a few Nature-lovers have been carrying on in this country an earnest campaign in behalf of the preservation of our native wild flowers and other wild plants. According to a review of these efforts published by Mrs. N. L. Britton in the *American Museum Journal*, some of the plants that stand in most urgent need of protection are the hepatica, trailing arbutus, moccasin flower, partridge berry, azalea and fringed gentian. These lovely plants are now nearly extinct in many parts of the country where they were once common. The preservation movement began in 1901, when, in consequence of an article on "Our Vanishing Wild Flowers," published by Mrs. Britton, the Misses Olivia and Caroline Phelps Stokes gave to the New York Botanical Garden a fund of $3,000, to be used for the "investigation and preservation of our native plants." The following year the Wild Flower Preservation Society of America was organized, and it now has chapters in several cities. The Society for the Protection of Native Plants was also formed, in Boston. The interest on the Stokes fund has been used to secure essays, leaflets, posters and lantern-slides for distribution, for illustrated lectures in schools and colleges, for providing prizes for schools taking part in the work, and for reproducing in colors the wild flower paintings of Miss M. E. Eaton. These pictures, showing rare wild flowers needing protection, have been distributed free to libraries, schools, colleges and museums.

Agricultural Research in Great Britain.—One of the consoling features of the war, so far as Great Britain is concerned, has been a marked increase in the amount of attention paid in that country to agricultural research and scientific agriculture in general. Some recent progress in these matters is reviewed in the Experiment Station Record. Some time ago the Board of Agriculture and Fisheries published a comparative study of British and German agriculture, in which it was shown that, although the soil and climate of Germany are the less favorable, 100 acres of land in that country feeds from 70 to 75 persons, as compared with 45 to 50 in Great Britain. Moreover, Germany has gained this advantage within the last 40 years largely through agricultural education and research. Thus, the use of artificial fertilizers has been notably increased and standardized. A definite movement is now on foot to bring about similar conditions in Great Britain, which has long possessed some admirable institutions for agricultural research, such as Rothamsted, but has been backward in spreading scientific knowledge and methods among the farming population. In Canada recent advances have included the establishment of an experimental flax mill at the Central Experimental Farms, and the opening of research laboratories in Manitoba and Saskatchewan for the study of grain rust. In northern Ontario, where marked efforts are being made to increase land settlement, an agricultural training depot is being organized for the instruction of returning soldiers; besides several demonstration farms, a plant breeding station, and an agricultural high school. The South Australian branch of the British Science Guild has drawn up plans for a federal institute for agricultural research in Australia.

Industrial Efficiency

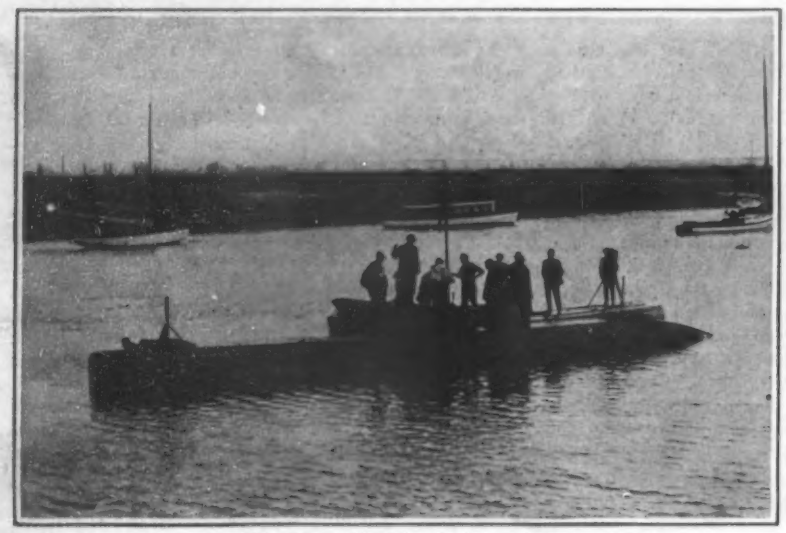
Economy in Store Deliveries and the War.—The retail stores of the United States are asked to introduce economies in their delivery services, in a letter which has been addressed to them by the Commercial Economy Board of the Council of National Defense. It is announced that an investigation conducted by the board has shown that many men and vehicles can be released for military or other service for the country by the elimination of unnecessary deliveries. It is urged that changes be made as soon as possible.

Taking the Business Along on a Trip.—The head of a well-known automobile company believes in keeping right on with his business details, no matter where work and pleasure happen to take him. To this end he makes use of a special trunk in which he has every book and record required in handling problems as they arise. In this manner, with the help of his secretary, this progressive executive manages to keep up with the details of his business; and when he returns to his office after a vacation or trip his desk is as clear as the day he left. In other words, there is not the mass of accumulated correspondence and details which, as a general thing, serves only to mar the pleasure of a vacation or trip. And it is said that the time given to these business details is so slight as to take little away from the complete rest of a vacation, if handled day by day.

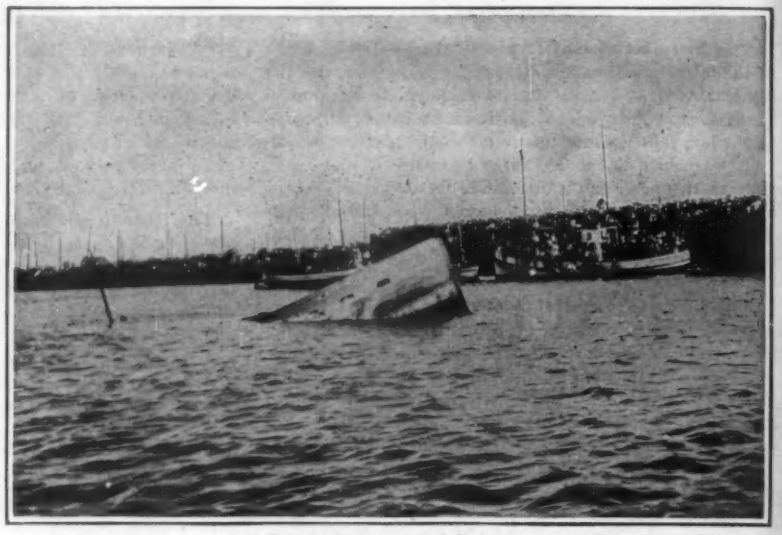
Keeping Down Compensation.—The safety department of a large motor car factory links up industrial accidents with poor health. They also link up accident prevention with poor health. With this in view they have built up an extensive medical service for their employees. The result is, with the same number of employees, they have cut the number of serious accidents 60 per cent—from 1,800 to 500. This reduction of two-thirds has been made in surprisingly short length of time. The men at the head of this company estimate the value of their medical service on the increased efficiency of their workers. This department relieves their employees from worry, physical ills and morbid imagination. This department, continues *Health News*, prevents illness which means loss of time to the company and man, loss of wages to the man and loss of service to the company. In the course of a year in the factory, employing between seven and eight thousand, the helping hand of service has been extended ninety-five thousand times. Grippe, colds, headache, small accidents, are treated cheerfully and willingly in the dispensary.

Use of Formed Solder.—In manufacturing articles having many soldered joints difficult to reach, it is good practice to furnish the solder punched or formed to fit the seam, as the time, labor and solder saved are important considerations; moreover, the formed solder is more likely to reach every part of the seam and insure a tight joint. An important manufacturer of automobiles makes use of a solder link stamped from a thin sheet of solder, in making radiators of the tubular type. The radiator element is built up of vertical rows of tubes pressed through thin copper plates. The ends of the tubes must be soldered tightly into the water chambers. The solder links are dropped over the ends of the rows of tubes and are melted with a blow-torch. The solder, being applied all around the tube in link form, runs down the tube to the tube sheet and makes a practically perfect soldered joint on five tubes simultaneously. It is obvious, concludes *Machinery*, that much time is saved by the use of formed solder links in confined places like this; in fact, it would be practically impossible for the workman to apply solder to all the tubes in a reasonable length of time unless it were furnished him in the stamped shape.

Findings of the Railroads' War Board.—The shortage of freight cars in the United States was reduced during the month of May from 148,627 to 105,127 cars—almost one-third. This marked reduction in one month, following four months of rapid increase, is attributed to the prompt response on the part of both shippers and railroads to the specific suggestions which have been made by the Railroads' War Board as to how to secure more effective uses of existing freight equipment. Some of those suggestions are: Load cars 10 per cent in excess of marked capacity; reduce percentage of cars and locomotives under repairs; improve methods of "firing" locomotives; defer scrapping light locomotives; speed up handling of cars in terminals by prompt despatch of trains; load and unload promptly; and enlist coöperation of shippers, as a war measure, to secure heavier loading of cars. The progressive improvement in the situation is indicated, in that on March 1st, reports made by railroads to the American Railway Association showed a shortage in the entire country of 130,082 freight cars. The shortage grew to 144,797 by April 1st, and on May 1st, when the Railroads' War Board was just starting to operate all the railroads as a continental system with the aim of producing a maximum National transportation efficiency, the shortage had reached 148,627 freight cars.



The Cage submarine in the water



Caught in the act of diving

Gas Engine Drive For Submerged Submarines

A California Experiment Which Aims To Supplant the Storage Battery

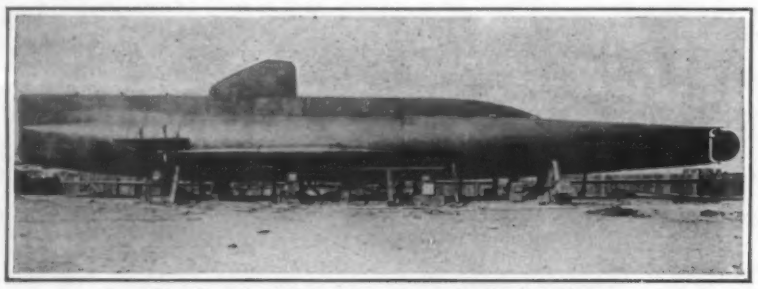
By E. C. Crossman

FOR running submerged the storage battery is not only the present standard practice of submarine engineering, but it represents the only avenue of attack upon the problem which has as yet led to results of practical value. Yet any submarine engineer with a broad vision of the future would admit, if you could but probe into his innermost secret soul, that while the storage battery is good enough to make submarine warfare a fact, it possesses drawbacks so serious as to render it out of the question for him to believe that it can stand permanently as the last word in sub-surface navigation. In first class condition and under first class conditions it is reliable enough. But a submarine when submerged furnishes almost ideally all the conditions under which a storage battery should *not* be operated. Insufficient ventilation, insufficient air for breathing, odors of oil, finely divided oil particles in suspension, battery gases and the odors of humans themselves, all conspire to produce a species of sea-sickness and general loginess that take from the efficiency of the crew. Under these circumstances, the evils of the long rows of acid-filled tanks, the gassing that takes place or threatens to take place during charging or discharging, become very real perils.

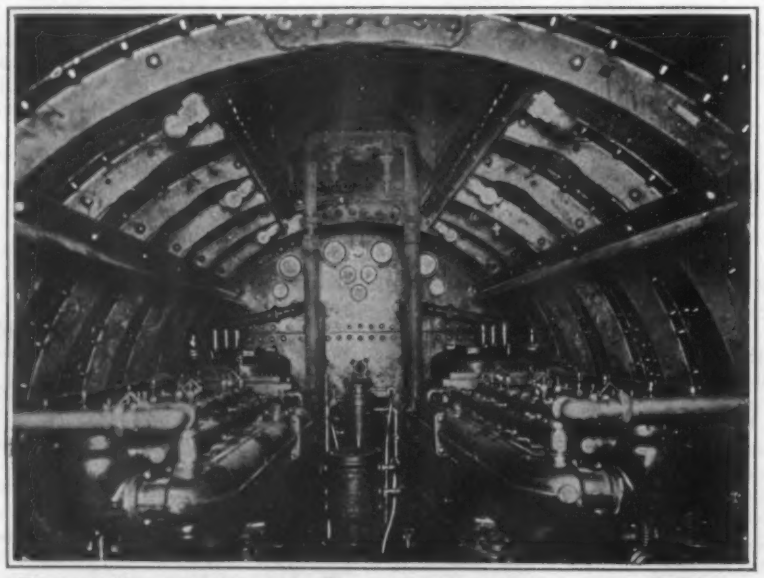
Moreover, as submarine warfare proceeds, it becomes increasingly clear that the ideal submarine must work under water more swiftly than the present storage-battery drive makes possible. The successful sub operates precisely as does the successful burglar or highwayman—a stealthy but quick approach, the attack, and the prompt get-away before the minions of the law can arrive in response to the wild shrieks of the attacked. It is not healthful in these days for the submarine to lie dead on the bottom for a day or so because when it comes to the top for a look-see or a supply of air there is the hopeful little boat with the hopeful little cannon waiting to plunk it and the hopeful little net waiting to tangle it up. High speed for a couple of hours spells the only sure safety for the shark, and high speed submerged is precisely what the electric storage battery cannot deliver. Every layman knows now that the storage battery, discharged rapidly as when the motors are driven at high speed, has a life better measured in seconds than in hours. With these facts marshalled before us, the following quotation from a Lausanne, Switzerland, press despatch is interesting. It refers, of course, to German procedure.

"The latest model submarine now in service has a single motor which is used both for surface sailing and for diving. This motor is silent and thus the submarine is no longer betrayed by the noise of explosion. The heavy and cumbersome accumulators with their dynamo are replaced by a lighter and smaller battery of oxygen pipes. Its speed under water is superior to that of most merchant vessels and in fact is no longer inferior to that of rapid mail packets."

Queerly enough this appeared some months after Mr. A. R. Neff, an American submarine man, formerly with the Lake Company had submitted to the German Government his application for a patent on a system for driving a submarine submerged, by means of the same gas engine used for surface sailing. Queerly enough again the Krupp Company, semi-official German corporation, promptly filed interference when the Neff patent was opened for inspection, although the patent was granted in every other country outside of Austria. The "Big Navy Bill," recently passed carried with it an appropriation of $250,000 for building and installing an experimental set of machinery on the Neff plans, in one of our E-type submarines. This was after careful investigation by the Congressional Committees and the testimony of various navy men, including the Secretary of the Navy himself, as to the desirability of doing away with the battery, and the chances that the Neff plan would be a success. Wherefore from the despatch detailing the German adoption of this plan, and the American resolve to go ahead with the working out of the plan, it would appear that the old storage battery has a fine prospect of meeting early competition.



The Cage boat out of the water, showing her lines



The operating mechanism of the Cage submarine, predecessor of the Neff boat. The pump in the center was not part of the permanent machinery

The Neff plan of submarine propulsion is based on the Cage design, which was tried out in a very crude 75-foot submarine built in California some years ago. In the absence of any photographs of Mr. Neff's boat we have illustrated this story from pictures of its predecessor, which it resembles very closely in all respects except that it is expected to run. The Cage boat displayed an alarming fondness for going to the bottom head-on and then trying to dig in, but during its moments on an even keel, the Navy board which investigated it became convinced of the feasibility of driving submarines submerged with the gas engine.

The gas engine has just two fatal habits that have thus far made it taboo for the boat under water. One is that it uses all the air there or thereabouts, which doesn't matter when air is plentiful. The other is that it has a bad breath and lots of it, which also doesn't matter when the whole outdoors is available for the dispersion of said breath.

So the first change in the standard submarine machinery—outside of derricking out the batteries and motors—is the installation of a pair of powerful air compressors driven off the main engine shafts, and then batteries of hundreds of air-flasks akin to the heavy tanks used for storing carbonic acid gas for the soda fountain. These flasks, holding air at a pressure of 3,000 to 3,500 pounds per square inch, are stored in the space formerly given up to the batteries, and in the spare space in the superstructure. A change to this type of boat would make redesigning the interior for the accommodation of air bottles a necessity for the best results.

In a boat of say 500 tons the present battery installation requires about 1,150 cubic feet. The air tank installation requires 1,700. But, where the batteries weigh with their motors about 200,000 pounds the air equipment weighs 160,000, a saving of 20 tons.

This is the air equipment to care for the greedy lungs of the big engines.

To put its breath overboard against the heavy pressure of the sea-water, a simple double-acting force-pump is utilized, and the motive power thereof is derived from the energy stored in the compressed air. This force pump, "mechanical exhauster," as Mr. Neff terms it, driven by the high pressure air from the tanks, takes all work off the engine, and puts the exhaust overboard without any back-thrust on the engine and any consequent loss of power.

In detail, with the air tanks full, the boat submerges and the air-intake pipe on the conning tower closes automatically against the entrance of sea-water. Air commences to flow from the great battery of tanks through a reducing valve to bring it down to the more civilized pressure of about 150 pounds per square inch. As it is cold it is then passed through a reheater, which in turn is heated by the engine exhaust, and its temperature is again raised to about 400 degrees. Then it is led to the motor cylinders of the mechanical exhauster or force-pump.

Its work done, the air is then passed through suitable mufflers to remove the pulsation and through oil separators by which all oil vapors are removed, then it is turned into the interior of the boat by various outlet valves.

(Concluded on page 146)

Spraying (at left), peeling and sorting (at right) tomatoes for canning

Canning Tomatoes in California

What the Professional Canner Is Doing to Preserve Perishable Vegetables

By Arthur L. Dahl

"CAN we feed ourselves and our Allies in these trouble-some war times?" was asked an Agricultural Expert recently. His smiling reply was: "We can if we can all we can."

Nature is both bountiful and destructive. The warm sunshine, the cooling showers, produce large crops, but the same agencies act as enemies to destroy their own handiwork unless man intervenes. The delicious cherry, the luscious peach, the succulent tomato soon spoil when picked from the parent branch, unless preserved or canned.

The entire world is facing a food shortage such as has not been known before in history. A large portion of the productive labor army is engaged in the destructive work of war. The United States has been called upon, as never before, to supply food for foreign countries. Hence, the saying of the Agricultural Expert is fraught with deep meaning. We must can, or preserve, or dry, or otherwise save every ounce of our fruit and vegetable crops possible.

One of our commonest and most productive vegetables is the tomato. It can be grown almost everywhere, and the yield is bountiful. It lends itself easily to canning, and no vegetable is more welcome in the home during the long winter days than the tomato with its juicy, acid pulp. In the country districts almost every good housekeeper includes the tomato in her list of things to preserve; but for the average city dweller this work must be delegated to the big professional canning factories. One of the largest and most up-to-date of these factories, located in California, the home of all preserved fruits and vegetables, is pictured on this page, with its batteries of machines of every description and its ranks of white-clad workers.

This packer makes his contract with the grower at the beginning of the planting season, and usually stipulates the variety desired. During the harvest season the tomatoes are picked every day and are canned and placed in storage before nightfall of the day picked. When they arrive at the factory they are sorted by hand and placed on conveyor belts which lead to the washer. Here they are immersed in clear, running water and then placed under strong sprays to remove the dust and dirt.

When thoroughly cleaned, they are conveyed through scalding water or steam, which loosens the skin so that they may be readily peeled. The steam or water is kept very hot in order to blister the skin before the heat has had time to penetrate into the tomato. The scalded tomatoes are then placed in a shallow pan which is carried on a belt to the preparation table, where the skins are stripped off and the core removed. Fancy solid tomatoes are sorted from those that are less firm.

The tomatoes are next conveyed to the canning tables, where they are hand packed. The "solid pack" brand is the whole tomato placed in the can with its own juice. Other brands range downward until some cans contain merely "puree" or tomato juice, to be used for soup or sauce.

After leaving the canning tables, the juice of the tomato, or the puree, is poured into the cans and they are conveyed on moving belts through the "exhaust box" which sterilizes them. From the exhaust box they pass to the automatic sealing machines, which seals the caps upon the cans without the use of solder or soldering acid. From the sealing machine they are run through the cooker for the proper length of time, after which they are loosely stacked to cool quickly, and then restacked in the warehouse. By leaving the cooking till after the canning and sealing, most of the annoyances which beset domestic canning are avoided. The labels are not put on until they have been sold and are ready for delivery.

To insure absolute cleanliness and to prevent contamination, all the utensils used in handling tomatoes are enameled so that the acid of the tomato cannot act upon the metal of the pan. Each pan or bucket is washed with hot water each time it is emptied. The scheme of not cooking them until they have been finally packed and sealed is merely a part of this effort to secure absolute cleanliness. Plainly no impurities can enter after this cooking.

Filling and capping the cans of raw tomato pulp

Cooking the tomatoes—after they are sealed in the cans

A Week's Review of the War, August 16th, 1917

By Our Military Expert

IT is now generally acknowledged that there is little hope of peace this year and that the war will go through another winter and into the spring of 1918. But the economic situation in the Central Empires is becoming each month more and more critical—a fact that, try as they may, these empires cannot hide.

It is of course realized that all sources of information which could give the true facts have been carefully suppressed, though hints are coming to the surface from time to time, even from official sources, that show the desperate economic, financial, and even military conditions that now prevail and that must continue to grow worse as the months pass. The distribution of food has given rise to many complaints and enough has been made known of food conditions to lead to the belief that many prisoners have died or are dying of slow starvation. If the late Chancellor von Bethman Hollweg made the statement credited to him that the best Germany can hope for is a drawn war, it must be that those best informed feel certain that Germany is beaten. The claim that the war was begun as a defensive one can certainly no longer be urged; even some high in authority who have recently written articles on this question, state that the main French armies at the beginning of hostilities were moved to the lines extending from Belfort on the Swiss border to the Belgian frontier and it was only after it was definitely learned by the French and English about the middle of August, 1914, of the advance of strong German forces up the left bank of the Meuse in Belgium that the French made most desperate efforts to concentrate on the west front. In fact, four German armies were advancing through neutral Luxemburg and Belgium toward the French frontier before the danger was realized.

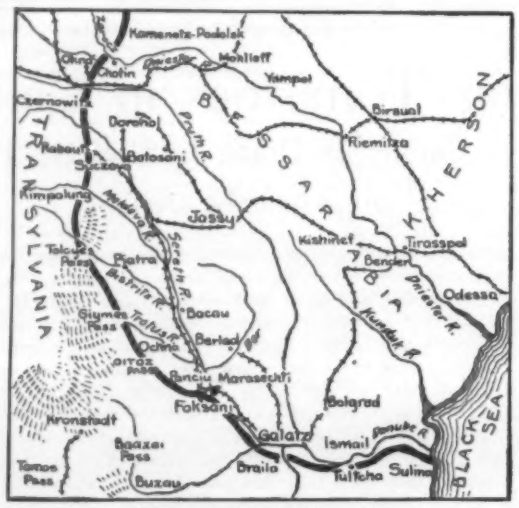
Although defeated at the battle of Marne because of the wonderful resistance of the allied French and English forces, Germany has so far been spared any serious effects of the war in her own territory; but the reckoning after the war when reparation, restitution, and indemnities are demanded will be quite another question. At present there seems to be greater harmony and unity of purpose among the Entente Allies than ever before; the addition of new powers to their ranks, such as China, Siam and even Liberia—while adding on the surface but little material strength—shows quite clearly what must be the reports to their respective governments of the various diplomatic agents who are closely watching the trend of events.

Just now indications are that for any serious influence on the conduct of the war, Russia is almost out of consideration. Although a stiffening of resistance on the eastern front is claimed at many points, the withdrawal of the Russian troops from the Galician and Bukowina fronts has but just come to a standstill and it is as yet quite doubtful whether successful opposition to the Austro-German troops can be offered. One hope lies in the fact, if reports are correct, that only old German classes of the Landwehr and Landsturm constitute the main part of the armies on the eastern front; if the Russian armies—now so demoralised—can be brought back to any state of discipline and organization, it is hardly probable that the German lines on this front would stand any serious hammering for any length of time. Another hope is due to the present conditions in Austria. It is known that her strength is dropping so rapidly that no great number of reinforcements can be drawn from the eastern front to produce material results on the Italian frontier. It is believed that this will be shown as soon as another forward movement of the Italian forces on the Carso front is begun. Present indications are that this will be at an early date.

Although the great retreat of the Russian armies has been a most discouraging feature of this year's operations on the eastern front, yet it must be acknowledged recent reports show that the Austro-German advance has been materially slowed down and in some places stopped altogether. The new Russian Commander-in-Chief, General Korniloff, has been making strenuous efforts to bring order out of chaos and to reëstablish discipline; in these steps he seems to have had some success but it would be premature to say that he has been able to set any limit to the German advance.

Northeast of Lemberg, near Brody, where the Russians have never given way, there has been desperate fighting with the results in their favor. In fact, it can be said that from the Pripet Marshes, around Pinsk, to the Dniester River on the south the Germans are not gaining. Around the Sereth River the German advance has been stopped although Czernovitz has been captured. The loss of this city, the capitol of Bukowina, has been a serious blow to the Russian armies; its fall has resulted not only in the cutting of the railroad lines leading into Russia, but also, what is more unfortunate, in cutting the lines leading south through the center of Moldavia, from which branch lines led to the Russo-Rumanian armies assembled at various points on the Bukowina, Moldavia and Transylvania fronts. Field Marshall Mackensen recognized the value of these roads when he moved forward from Focsani to capture Marasechiti on the railway that forms a lateral supply line for the Russo-Rumanian forces. It is evident that the Austrians and Germans have broad plans in view. It would seem from the attacks now being delivered by the Austrians in Bukowina that they intend to advance down the valleys of the Bistritza, Sereth and Suchawa rivers into Moldavia. If Mackensen can move north and the Austrians from Transylvania can press east, there will be a converging movement upon Jassy, the present Rumanian capital. It seems very probable that the Russo-Rumanian armies must soon withdraw behind the line of the Sereth River which in its north and south course divides Moldavia into two practically equal parts.

The fighting qualities of the re-organized Rumanian armies appear to be of the best and combined with the strong assistance of the southern Russian forces, have shown a marked contrast to what has happened farther north in Bukowina and Galicia. It is evident that Marshal Mackensen is finding his advance from the south no easy matter for he has gained only a few miles; it is highly probably not only that his best troops have been withdrawn but also that he has now with him not enough troops to make his advance effective. Should the



The operations in Rumania

contrary prove to be the case and should Jassy fall, the whole of Rumania would be in German hands and the Rumanian army and government would be forced to retire into Bessarabia, establishing a capital either at Odessa or Rostov. The lastest advices state that the Germans have taken the important railway station of Panciu north of Focsani after desperate resistance by the Russo-Rumanian troops. Panciu is the end of one of the branch railroads that supply the troops in neighboring valleys on the Transylvania border and its fall cuts off the line from the main railway running north and south through Moldavia along the west bank of the Sereth River. It therefore now seems inevitable that the Russo-Rumanian forces must retire to the eastern bank of the Sereth to avoid being cut off from their base. As it is stated that the diplomatic bodies are leaving Jassy for Odessa, it must be deemed a great risk to remain there. Jassy is only a few miles from the Russian frontier and its fall would mean the complete occupation of Rumania by the Central Powers. It is hardly probable that any German advance upon Odessa 150 miles away would be attempted for this would mean too great a distance from the bases of supply and consequently a neutralizing of offensive powers.

On the western front, the heaviest part of the offensive is steadily moving to the northwest from France into Flanders where the strength of the German forces have been massed against the concentrated attacks of the Belgians, French and especially the new English armies. There have been three smashing blows this year—around Arras, at Vimy Ridge and again at Messines. Each time, the blow has told and other strong ones are impending; these all accomplish what they are intended to do; viz, to wear out the German army and to break it to pieces by a slow grinding process. While general strategy on this front indicates an intention to get around the right flank of the German lines, the object primarily is so to reduce the numbers and material of the German forces that the lines can be broken in several places and the resulting isolated flanks can be turned. This will require an enormous prepared preponderance of men and guns, and, with a full command of the air for observation purposes, can be carried out; it would mean the defeat and possibly the annihilation of the German armies. So long as the British and French losses are less than the German and so long as the added strength of the American contingents can be counted upon, the Allied superiority must constantly gain.

Recently much has been said of the growing weakness of France due to her losses, and that she was being "bled white." Her losses were great, very great while she was holding Germany back until her allies could get ready. But the long continued and desperate attempts of the Germans around Verdun and recently along the Chemin des Dames and the Craonne plateau have been successfully repulsed with very much heavier losses to the Central Allies than to the French. Their efforts along all their lines have shown their willingness and ability to fight and have rendered effective their wonderful opposition to German advances. Conditions in their ranks must have improved for older classes in the army have been honorably discharged and many have been released for farm work and for work in munitions factories. An excellent summary of the military situation in France was recently shown in a letter from a high commissioner of the French Republic to our Secretary of War. Among other remarkable statements is the fact that France has now in the fighting zone three million soldiers, one million more than were on the fighting front when the war began. This number is exclusive of the numbers that she has in the ranks in the colonies or in training in other locations. It is claimed that she has increased her man force by constantly decreasing the percentage of casualties, which has steadily gone down each six months. During the second half of 1916, the percentage of casualties of the total number of men mobilized was only one and one-fourth per cent—this includes killed, wounded, and missing. All this is in direct contrast with German methods where apparently losses are of no consideration where results attempted or obtained are concerned. The production by France of artillery and munitions during the war has been marvelous. Not only has she been able to produce enough guns of all calibers for her own purposes but she has been able to furnish 800 guns for her allies and to reëquip and re-arm the Belgian, Serbian and Greek armies. To realize slightly the enormous amounts of ammunition that are being manufactured, it is now arranged that 250,000 shots may be fired daily from her field guns and 100,000 daily from her heavy guns. Such quantities can scarcely be grasped under ordinary peace conditions; they give some idea of the necessary costs of war.

At present operations in the western front are largely made up of isolated raids and actions, both sides preparing for the next drive that may come at any time. The British are tightening their grip on Lens, which coal city must soon come into their possession. The capture just reported of Hill 70 to the north of Lens by the Canadian troops ranks in importance with the greatest military operations of this year. The hill dominates the Loos salient and the city itself and is to Lens and Loos what the Messines Ridge was to Ypres. This success, which was obtained after a long continued and heavy bombardment and also after a surprise attack, will undoubtedly hasten the fall of the city itself.

To the northwest the French have advanced at some points northeast of Ypres. The artillery duel that has so long prevailed in Flanders has reached a pitch of intensity seldom equalled; but at exactly what point the next blow will fall on the Germans cannot be foretold. The latter have long since given up offensive movements on a large scale and uniformly hold themselves in strong defensive positions. There has also been comparative quiet along the Aisne, in Champagne and around Verdun although artillery duels are constantly in evidence. These are said to have been especially severe in the Champagne region and on both banks of the Meuse River northwest of Verdun.

It is believed that there have been recently a number of withdrawals of Austrian troops from the Italian front to stem the Russian advance in July and later to extend the victory over the retreating Muscovites. At present it is thought that the bulk of their forces have been arranged along the Isonzo River and on the Carso plateau to hold back further Italian movements toward Laibach to the northeast or toward Trieste to the south. The difficulties under which the Italians have carried on their operations cannot be exaggerated for they are holding a front longer than the combined British, Belgian and French fronts—more than 450 miles. It is said that if the trench lines held by the Italians were in a straight line they would extend from New York to Salt Lake—2,500 or more miles; most of these trenches have been blasted from solid rock. When everything is considered, probably the most remarkable fighting carried out during the present war has been that on the Trentino and the Julian fronts.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Moving Platform Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial on page 72 and the unsigned article on page 77 on proposed Hudson River highway tunnel correctly state serious objections.

Permit me to suggest that the danger attending the operation of gas vehicles in the tunnel may be eliminated by providing moving rails or belts upon which the cars are propelled through the tunnel while their own motors are shut down. The cost in horse-power would be practically the same.

Tracks at each exit should be raised several feet above street grade to provide a down-grade sufficiently steep to move autos by gravity until under their own power. This especially for cars having no self-starter. The down stretch should be wide enough to take care of lame ducks.

For my suggestion I submit the following advantages:

Uniform speed for all cars, including trucks.

Saving in widths of road-bed for autos.

Eliminating collisions.

Cars reach moving track on down-grade. First section of track low speed. Speed increases gradually to 20 miles per hour and reduces again at exit.

F. H. NAGEL.

Neppel, Wash.

That Vehicular Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

In re the letter under correspondence in your issue of Aug. 4th "an Engineering Chimera" and your editorial on the same, it occurs to me that "New Yorker" has made an error in one of his assumptions. He assumes the average horse-power of all cars using the tunnel to to be 15, whereas a medium weight five-passenger car uses in the neighborhood of 1 horse-power when traveling at 8 miles per hour which would be a fair average speed under the conditions of the tunnel.

Most cars under test conditions use considerably less; small ones about the same due to greater friction. I have no information in regard to trucks, but assuming a value of 2 gives a generation of 96 cubic feet of CO per minute instead of 720 and an air speed of 21 miles per hour instead of 160.

On end to end ventilation the velocity of air becomes 4 miles per hour.

HOLLOWAY KILBORN, E.E.

New Haven, Conn.

[This correspondent's point is a good one, although not, in our judgement quite so good as he would make it out to be. It is notorious that cars running on low speeds, while they may only "use" one horse-power or thereabouts, must burn a great excess of fuel in developing a single horse-power in an engine rated at 15 horse-power, more or less. It is at least pertinent in this connection that while the Public Service report does not specify what amount of monoxide is assumed to be generated, working backward from the results obtained by the company engineers shows that their assumptions here were little if any different, from those of "New Yorker."—THE EDITOR.]

The Torpedo Battle-Cruiser

To the Editor of the SCIENTIFIC AMERICAN:

The failure of the modern automobile torpedo to account for more ships in the naval engagements of the great war can not be attributed to the inefficiency of the torpedo itself. On the contrary, it is a wonderfully efficient weapon, and probably the most perfect piece of naval mechanism in existence. Its failure against warships is not altogether due to the human element either, though, indeed, the difficulty of estimating the distance, speed and course of a rapidly moving enemy vessel has a great deal to do with it.

By a comprehensive study of the subject, one is led more and more to the belief that the ideal type for the use of the torpedo as the main weapon of offense, has not yet been found. A properly screened fleet of dreadnoughts is immune from submarine attack. Even if a submarine should get close enough to discharge one of its torpedoes, the chances are that it would be either sunk or driven off by a keen-eyed destroyer before it had time to follow up its advantage. Previous to the war, the Germans placed high hopes in the ability of their excellently trained destroyer flotillas to play an important rôle in whipping the enemy's battleships. They tried hard at Jutland under the most favorable conditions, but failed to account for a single ship. This is nothing more than a further proof that a new type of vessel which can use the torpedo to its full effectiveness, is yet to be invented. The best use of the destroyer is in screening operations. For this purpose it is indispensible to the battleship during an action.

The methods of defense against torpedoes have been greatly improved since the beginning of the war, but it would be beyond the power of man to construct a vessel capable of withstanding the terrific shock of a number of these deadly weapons, fired simultaneously. Hence the value of a large, heavily armored vessel, of great speed, using the automobile torpedo as its main weapon of offense. The value of such a vessel has already been foretold. It would be known as the torpedo battle-cruiser, and it would combine the armor protection of the dreadnought with the speed of the fastest destroyer. In contrast to the battle-cruiser, guns instead of armor protection would be sacrificed for speed, and in place of guns, the torpedo would serve as the chief weapon. Through the complete absence of great guns and turrets, and hence the great decrease in weight, a speed of 35 or 36 knots might be attained, with the heaviest possible armor protection. A vessel of this kind would be invaluable before and after a battle, to hamper the enemy before the engagement and to further his destruction after the engagement. In company with destroyers and light cruisers, it could break through the enemies' cordon of light vessels and deal a sudden and stinging blow to his dreadnoughts. Indeed, it would be exposed to a terrific gunfire, but the armor protection would be far heavier than that of any existing warship, this being made possible by the total absence of large guns and turrets. Racing along at full speed it could approach the enemies' battleships and deal them a crushing blow with its broadside of at least fifteen submerged tubes, and a total of over thirty, relying on its great speed to get away.

The suggested type would be the very embodiment of the fundamental principle; the suppression of everything not absolutely required for purposes of naval warfare, or for life on shipboard. No turrets would be mounted on the spar deck, and aside from super-structures, provided at either end, a heavily armored smokestack and a basket mast, for wireless purposes, the decks would be practically vacant. The armor belt, extending from a few feet below the water line up, and running along two-thirds the length of the ship, would be more than sixteen inches in thickness. Due to the increased high angle of gunfire, and the growing importance of aircraft, particular attention would have to be given to the protection of the deck. A battery of ten or more six-inch rapid fire guns, for use against destroyers, and a number of anti-aircraft guns, would be carried. The dimensions would be as follows: Length about 600 feet on the waterline; breadth 88 feet, and draft 25 feet. The cost, exclusive of torpedo equipment, would be in the neighborhood of $10,000,000. The saving in personnel would be a most valuable feature, for the complement of the torpedo battle-cruiser would be small in comparison with that of our latest superdreadnought.

This proposed type was suggested by naval officers, prominent in the torpedo branch of the service, and it is their belief that two or three of these vessels would be most valuable assets to our fighting fleet, particularly at the present time.

W. D. REICHMANN.

Chicago, Ill.

[The idea of building a torpedo-cruiser is not new; in fact, we published a few years before the war a design for such a ship, which was being considered by the Russian navy. In the above design, the estimated cost is far too low for a ship of the proposed 35 knots speed.—ED.]

Hydroplanes for Merchant Ships

To the Editor of the SCIENTIFIC AMERICAN:

Many suggestions have been submitted, telling how to do away with submarines, but this one you will agree is considerate of some thought.

Instead of the Navy spending so much money for small, speedy craft for which we will have no use after the war, why not build a larger merchant fleet and equip it as well as *all ships* now plying the seas, with a large platform built over the superstructure to accommodate a large hydroplane.

On account of the height of the platform I believe it possible for them to be launched with two men on board without striking the water. In case submarine or periscope were sighted the hydro could be off in an instant to the spot, before the submarine could submerge to such a depth that it could not be destroyed by suitable projectiles being dropped on it from the hydro by one of the men, and if the submarine persisted in staying afloat it would be a good mark for the guns on board the ship in attendance on the hydro or from which it had just flown.

On completing its work it could return to the side of the ship and by suitable derrick be lifted again to its platform.

All this is hazardous enough but better than what we are doing now. Even if the ship were hit by a torpedo there is still a possible chance of getting a hydro launched and going after the offender.

These platforms could be quickly and cheaply constructed on all existing ships, hydroplanes cost no more, if as much as one torpedo and could be turned out fast enough for our immediate wants, and I believe we have airmen in sufficient numbers that would volunteer for such work.

All ships should, of course, be heavily armed as at present with expert gun crews on board.

The moral effect of such an arrangem would finally compel the submarine commanders to keep out of sight for fear of the consequences or return to their bases and abandon the present mode of destruction.

J. S. PLANK.

East Orange, N. J.

A Submarine Blockade

To the Editor of the SCIENTIFIC AMERICAN:

Like many others I have a suggestion to make for combating the submarine menace. If you think the suggestion of any value, please forward it to the proper authorities. If you think it of no value please discard it.

My idea is to establish a blockade of German ports by means of two or three lines of small submarines. It is generally accepted that one submarine is not a defense against another, and when the submarine is in a submerged position this is probably true. It is, however, impossible for a submarine to travel any very great distance in a submerged condition. So that it seems to be their practice to travel on the surface as much as possible, and only submerge upon the approach of another vessel. At the time the submarine merchantman visited the United States it was frequently stated that she had traveled submerged for less than fifty miles during the entire trip. The ability of the submarine to submerge quickly renders it extremely difficult for surface craft to attack them successfully, and enables them to travel on the surface most of the time.

The use of submarines on blockade, however, would change this condition. They could maintain their position just at the surface of the water but lying very low in the water, so that it would be very difficult for an enemy submarine to see them until at very close quarters. The blockading submarine would have the advantage of being stationary and watching for a moving object.

Possibly the best place for such a blockade to be established would be between the Shetland Islands and the coast of Norway. Undoubtedly a considerable part of this channel could be successfully netted. Across that part of the channel too deep for nets the submarines could be ranged in two or three lines spaced so far apart that an enemy submarine could not pass under all of them without coming to the surface. The exact position of these lines could be changed occasionally so that they would not be known to the enemy. If a sufficient number of submarines were used it would seem to me impossible for the German boats to get through.

The blockading submarines could be small. Only large enough to accommodate two men, one of whom could be constantly on watch. They would have a low speed as they would not be expected to pursue the enemy and would need only speed enough to reach their positions and maintain them. They could be provisioned by other ships so it would not be necessary for them to leave their positions often. They would not need much ability to submerge, as they would be in an awash position while on blockade. They would not need to use a large torpedo, as even a very small one would rupture the light plating on a submarine. They could be standardized and built in large numbers at a comparatively low cost. They could be easily transported to England in a knock-down condition and assembled there.

These boats would probably be poor sea boats and the men in them would probably have an uncomfortable post. However, their crews could be changed frequently and the men given a run on shore.

Some of these boats could undoubtedly be used to advantage in a closer blockade of the enemy ports, and if equipped with a signaling device might give valuable warning if the enemy fleet should come into the open.

G. H. VINEYARD.

St. Joseph, Mo.

Air Cushions for Ships

To the Editor of the SCIENTIFIC AMERICAN:

I was particularly interested in the suggestion made by Albert F. Shore, in issue of June 23d, to use an air cushion for the protection of ships, as it is identical with an idea that occurred to me some time ago.

I believe that the cellular air spaces should extend above the surface of the water, being closed at the top with valve-like arrangement that would be opened by the force of an explosion allowing a part of gas generated by the explosion to escape upward.

I have often observed in blasting rock, that if a transverse fissure exists near the seat of the charge, even though it be very small, half of the force of the explosion would be lost through this fissure. I believe this arrangement would provide a like escape for part of the gas generated by the exploding torpedo.

If this idea could be used in connection with the one proposed by Mr. Maxim the danger from submarine torpedoes would be reduced to a minimum.

EDWARD E. HIGGINS.

Sandyville, W. Va.

Lewis gun mounted on an "arc" support for use against aircraft. Note the grain stacks used as camouflage

Officer and man of British M. G. Corps carrying a German machine gun into position for use against original owners

The War of Specialists—The Machine Gunner

How the Machine Gun Has Influenced Modern Military Tactics

By Captain Louis Keene, C.E.F.

Photos. Copyrighted, International Film Service

TO go back to the origin of machine guns it is necessary to go back through the centuries to the old Chinese gun, taken prize by the French in 1860, which now is reposing in the French Military Museum. This gun consisted of four iron barrels fired simultaneously, and it is believed to have been made earlier than 1300.

Since 1830, a breech loading battery, or, as it was then termed, "Organ Gun," has been in the Rotunda Museum at Woolwich. This gun consisted of rifle barrels in three parallel rows to the number of 31, which were loaded simultaneously by means of a set of chambers all fired at the same instant by a single cap. At the siege of Charlton, in 1863, one of these batteries was in use and did a considerable amount of damage.

The "Mitrailleuse," twenty-five to twenty-seven barrels hand operated, was kept as a great secret by the French until the Franco-Prussian war of 1870-71, but unfortunately it was used at long range as a piece of artillery by artillery gunners.

Then came two guns, both hand operated, the Gardner and Nordenfeldt; but it was not until 1883 that the first *automatic gun* was invented. This was made by Hiram Maxim. So good have the results been that the guns operated on this same Maxim principle are practically the same as the gun originally adopted by the British in 1889, and are at the present time almost universally used in this war by all other warring nations.

The Manchurian campaign showed the value of machine guns; both armies made frantic efforts to obtain machine guns before the war had been waging very long. Again, the Balkan wars showed the benefit of machine guns, the Turks making, on occasion, good use of them; but the Germans alone profited to any great extent by this experience. They bought enormous numbers of guns and trained their men in peace time to a very great state of efficiency, the result being that they placed so much faith in these weapons that they had a corresponding fear of machine guns handled by their opponents and made every effort to locate them and knock them out.

Lewis gun mounted on a heavy "Mark IV" tripod, reversed to give it an all-around traverse, firing at an aeroplane

A machine gun can do the same work as 100 men armed with rifles. That is, it can bring the same amount of fire to bear as 100 riflemen and will take up considerably less room. Consequently, it is possible to bring a tremendous fire to bear from a very restricted space—a sap head, corner of old trench, anywhere almost. Imagine a machine which is capable of doing the work of 100 men and requires a frontage of only about a yard, as a reserve power. To bring its equivalent, 100 men, across the "Tops" or through communication trenches takes time, causes obstruction of traffic, and is also conspicuous. In a crisis, or at a threatened point, machine guns are invaluable. The machine gun, being inanimate and mounted on a fixed tripod, is not affected by the excitement which is always present during action.

Machine gunners are highly trained specialists picked on account of their qualifications and specially trained to their work. It is considered in the British Army a point of honor to keep your gun going. Consequently your reserve power is easier to handle, requires fewer orders, takes up much less space, and can be relied on to do the utmost.

Germans from the start have been using a great number of machine guns, therefore saving a large number of men. A few men with a large number of machine guns can do the work better than a large number of men with rifles. In brief, it is simply the use of a "labor-and-man-

Vickers machine gun and first and second gunners wearing gas helmets. This gun has two tripods: one heavy and a small field mount folded up under the gun forward

The Lewis gun fired from the shoulder, showing adaptability for quick work without tripod. Most of the recoil is taken up by the gun, and it is, in consequence, easier on the shoulder than many rifles

saving machine" as an enemy-killer, and a man-saver by enabling commanders to have fewer men in the front and keeping more men in reserve ready for an emergency. The Germans trained men in a special separate organization, the Machine Gun Corps, gave them special pay, special uniform, and extra privileges. This unit was entirely separate from other branches of the service; consequently the information and experience gained in the employment of their arms at the very outbreak of war was quickly assimilated and used to advantage. Similar corps had been suggested by the British authorities, before the war, but this had been rejected on account of expense.

A motorcycle machine-gun battery on the road "up". The writer of this article was with one of these batteries at the front

British guns, individually, did magnificent work at the beginning; but the coöperation which can be carried out only when machine gunners are in a special arm of the service, did not come until we had taken the machine gunners away from their battalions and put them under more central control. It is impossible to estimate the limits to which machine gunnery can go. Coöperation in machine gunnery now extends over the entire front from the North Sea to the Alps.

Great efforts are made to prevent a machine gun carrying out its full powers by either side. The enemy and ourselves will at no time hesitate to turn a battery of artillery onto anything that even looks like a machine gun or machine-gun emplacement, and, if necessary, shells of large calibre will be used in the endeavor to knock it out.

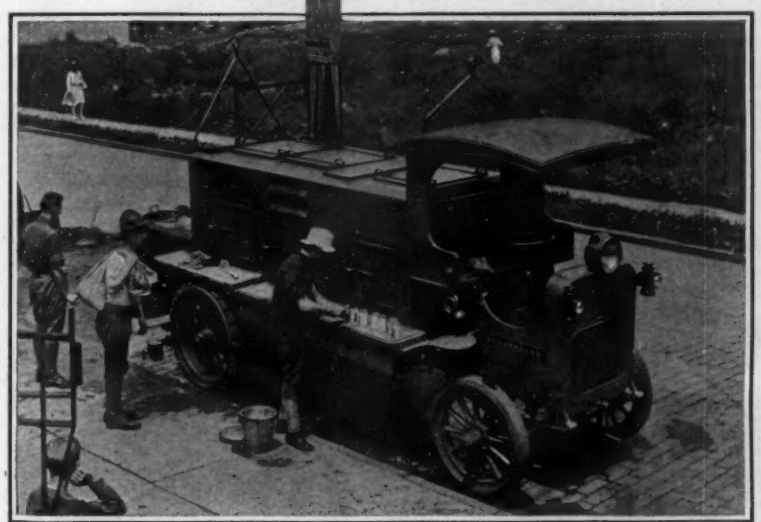
At Hullock, September 1915, 9.2 and 12-inch guns were used on the troublesome machine-gun emplacements, and more recently it was necessary to send out the "Tanks" before it was possible to advance. If a battery can knock out 100 men it is worth while; therefore, they endeavor to knock out similar value by "strafing" the machine gun. When it is considered that one machine gun will hold up a battalion,

(Concluded on page 147)

A Motor Kitchen Which Follows Our Army In the Field

ONE more proof that the United States is destined to be the best motorized army in the great European war is presented in the accompanying illustrations, which, together with our cover design, depict the last word in "chow wagons."

The present motor kitchen was presented to the 22d Engineers by Louis Sherry of New York City. The body proper, mounted on a powerful motor truck, contains three main compartments: first, a refrigerator, nearest the front end; second, a storage space for flour, coffee, tea, and other non-perishable foodstuffs; and third, a small oven, which is placed next to the range. The last-mentioned member is at the rear, and protrudes beyond the motor truck proper as will be noted in the illustrations. Handling four big kettles or pots at a time, the range can take care of the food for a large number of men, while a derrick and block-and-tackle arrangement over the range permits of the ready handling of the huge containers. The "cook house" is provided with a number of hatches for gaining access to the various compartments, and suitable loops are provided to facilitate the loading and unloading of the motor kitchen aboard steamer or railroad car.



This last word in "chow wagons" comprises a refrigerator, a storage for food, an oven, and a range

It is reported that the members of the 22d Engineers have been well satisfied with the "chow" turned out by their motor kitchen, and it is not unlikely that the idea will find favor with the military authorities. The present model is said to cost about $7,000, complete.

The War and British Industries

THE struggle between Britain and Germany for military supremacy had a more or less industrial beginning and has already led to many results in that field. Among these we find particularly the establishment of a far greater degree of industrial home rule than England has ever before enjoyed. One of the most important steps leading to the wresting from Germany of the commercial supremacy which she has so long enjoyed in many important trades was an exhibition of German and Austrian goods which was held recently in the larger Midlands cities, at which it was possible for the English manufacturers to see and handle comprehensive collections of samples of the many products of the Central Empires. It goes without saying that this is a detail of great importance—any Japanese manufacturer can testify as much.

As a result of this exhibition, new factories will shortly be completed in Wolverhampton for the manufacture, on a large scale, of wrought enameled hollow-ware and of artificial silks. In another part of the Midlands a brush-making machine formerly controlled altogether by the Germans is being manufactured, while a welcome stimulus has been given the glass industry, especially the making of flint glass. In the Sheffield district very important developments have been made in heavy steel industry, and it seems that electrically melted steel from this region will play an important part in the future struggle for supremacy. At the present moment a large number of electric furnaces are in use, chiefly in the production of alloy steels for constructional purposes; and to an increasing extent these steels are replacing the crucible metal for carbon and high-speed tool steel.

At the beginning this boom was handicapped by the total lack of any source of tungsten supply. While military considerations make it impossible to state definitely how this deficiency was made up, we can at least assert that there is now an ample supply for all needs, more than half of which is drawn from British dominions. This, of course, will be a great factor in the post-bellum situation.

In the making of dyes the British chemists are doing as well as could have been hoped for. At least one dye which the Germans were very confident could never be produced by any one but themselves is being turned out by two entirely independent British firms. An analogous triumph is the making of gelatine in sheets by a Belfast concern, in spite of the very wide-spread conviction that German methods here could not be duplicated. This substance has wide use in enameling and in imparting a washable surface to show cards. Even in the making of lenses—perhaps the one field in which the tradition of German superiority has come closest to being a set superstition—the British have succeeded both in duplicating German work and in evolving an improved type of lens for the special work of photographing from aircraft, which has enabled the members of the Royal Flying Corps to obtain pictures superior to any work which the enemy could execute.

Altogether, it begins to appear that Germany was entirely too light-hearted in her assumption that her trade would be but temporarily alienated by the disturbance of the war. She has certainly lost many valuable customers for good, and will find this out, to her sorrow, whenever after the war she is in a condition to begin a campaign to regain them.

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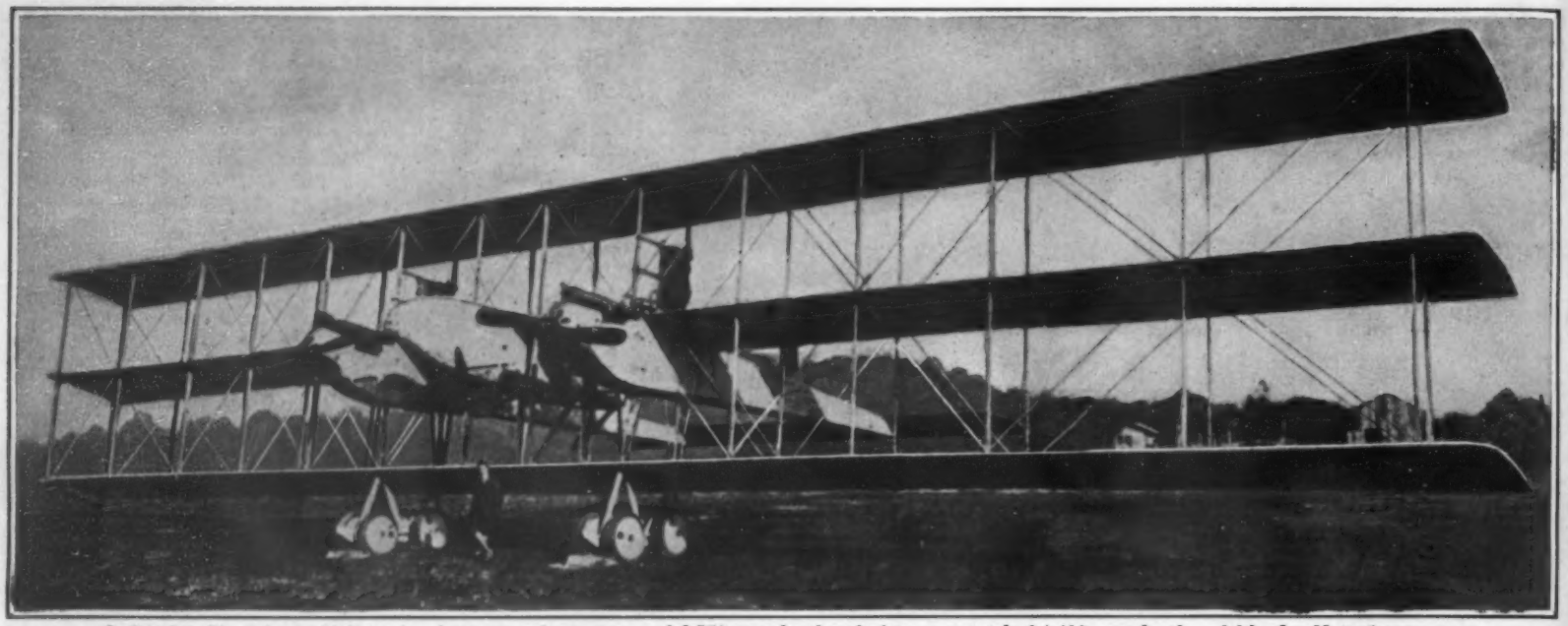
Motor kitchen of the 22d Engineers in full blast, as seen from the rear or range end

The Current Supplement

THE atom and its properties apparently lies close to the foundations of all chemistry and physics, and anything that adds to our knowledge of the subject is of the utmost importance to scientists. In the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2173, for August 25th, will be found a report of an important paper on *The Complexity of the Atom* by one of the leading authorities on the subject. Many people have wondered how it is possible to operate the big guns with which the latest German submarines are said to be armed. *The article on Disappearing Guns for Submarines* explains and illustrates the method of mounting such guns, and shows that the original design came from Russia. *Every Man a Leader* treats of the psychology of leadership, and will interest everyone in these days when there is such a demand for men capable of conducting the operations of our armies and their maintenance. *Iron-Stemmed Carnations* tells something of the cultivation of splendid specimens of this flower having stems sufficiently strong to support them. Several excellent photographs accompany the article. *Chemical Reactions of Iron Smelting* is a very readable review of the processes as carried on today in this very important industry. *The Cathode Ray Tube and its Applications* is a valuable addition to our practical scientific knowledge, and the paper is illustrated by a number of explanatory diagrams. *Radio-Active Luminous Paints* describes substances that have been found of value for many purposes in the prosecution of the war. In view of the steadily increasing shortage of fuel oils the article on *The Oil Fields of the Apsheron Peninsula*, describing an immensely rich field in Russia, is of interest. There is a short note on *Clearing the Way for an Advance*, accompanying a striking picture of the blowing up of a German stronghold. Other articles of value include *New Colorants from Methylene Blue for Microscopic Specimens; New Antiseptics; An Emergency Ration* and *Aluminium*.

Health Conditions in Brazil

THE International Health Board of the Rockefeller Foundation has recently completed an infection survey in the state of Rio de Janeiro, Brazil. Among 7,000 persons examined for uncinaria (hookworm) no less than 82 per cent were found to be infected. Dr. G. K. Strode, who is engaged in this survey, believes that malaria is equally widespread. The board is now organizing an intensive campaign with a view to eradicating hookworm disease in one district of the state, and it is hoped that this demonstration will stimulate general activity on the part of the native health authorities. The work of the board is soon to be extended to the states of Minas Geraes and São Paulo.



Italian bombing-plane which carries three men, three guns, and 2,750 pounds of explosives, or a total of 4,400 pounds of useful load. Note the man standing below the nacelle, to gain an idea of the size of the machine

Giant Bombing-Planes—Italy's Contribution to Aeronautical Progress

THAT Italy should be in the lead as regards giant bombing-planes must needs be a surprise to the laity; but to the world of aviation it is only regarded as the logical outcome of a persistent, carefully conducted effort along lines bound to bring results. Early in the war Italy introduced large bombing-planes of the Caproni type, and since then Italian aeronautical engineers have quietly been developing this class of aircraft. But all the while they have not forgotten for a moment the cardinal importance of the swift scout and fighting types, and even in these classes Italy is unexcelled.

Typical of Italy's large bombing-planes is the one shown in the accompanying illustration—a Caproni triplane equipped with three 200-horse-power Isotta Fraschini engines, or a total of 900-horse-power. This machine can readily carry three persons and 2,750 pounds of bombs; indeed, the total useful load is 4,400 pounds—fuel for six hours, a crew of three, three guns, and 2,750 pounds of bombs. The giant bombing plane is said to make close on to 80 miles per hour, and is ideal for bombing Austrian military establishments and for anti-submarine work.

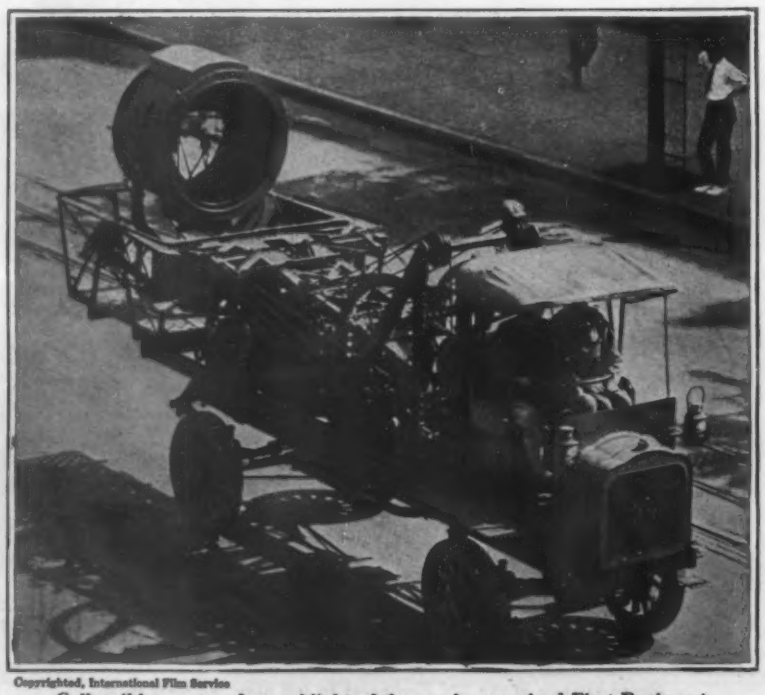
Major R. Perfetti of the Italian Royal Flying Corps, recently stated that Italy has developed a machine of 900 horse-power, capable of carrying three tons. Also, the Italian aircraft constructors have reached a point where an aeroplane of 1,000 horse-power can be turned out, carrying over three tons total load and with a cruising radius of 300 to 350 miles. In their experiments with powerful engines Italian engine builders have developed 700 horse-power engines, and at present 1,000 horse-power engines are being contemplated. Incidentally, Major Perfetti calls attention to Italy's aeronautical progress in other lines: the fastest aeroplane in the world, with a speed of 139 miles an hour; the fastest seaplane, with a speed of 112 miles an hour; and one of the best climbers.

Corkscrew Rods Which Hold War's Barbed-Wire Entanglements

THE longer the war goes on the more standardized become military methods; indeed, what were merely makeshifts at the beginning of the war have long since been replaced by elaborate devices and equipments turned out by the tens of thousands. One item, for instance, is to be found in the posts used for supporting barbed wire in forming trench entanglements. Formerly the soldiers used rough tree trunks cut down in a nearby wood, and crudely shaped. At the present time the soldiers make use of long iron rods with a corkscrew at one end and an eye at the other. These are manufactured in large numbers, and enable the men at the front not only to erect a barbed-wire entanglement in a short time, but to erect a better entanglement than was possible with the erstwhile wooden posts. In the accompanying illustration a British "wiring" party is seen on its way to the front, carrying the new iron post.

Elsewhere in this issue there appears an article on machine gunners, in which the importance of barbed-wire entanglements is dealt with at length.

A British "wiring" party on its way to the front. Note the novel corkscrew iron rods which are now used for supporting barbed wire



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Collapsible mast and searchlight of the newly-organized First Regiment of United States Engineers

Packing Glassware So That It Will Not Break in Transit

AMERICAN cut glass, especially the cut glass with silver trimmings, is winning an enviable place in the Peruvian market, and will not easily be dislodged even when normal commercial conditions are restored. On account of the practical certainty that the trade will have a large growth, it is quite important that American exporters of this class of goods should give attention to the most approved method of packing them, in order that they may not be at a disadvantage in meeting competition from abroad.

Persons who travel on the west coast of South America have observed that shipments of plate glass are liable to have dropped upon them at any time a ton or two of lard, cement, hardware, steel rails, or other goods, especially in such ports as Eten, Pecasmayo, Salaverry, etc., where ships are discharged in an open roadway, and are exposed to the surf, which is running on this coast. Glass must be so packed as to withstand such treatment, if it is to be successfully exported to Peru or Bolivia.

The Belgian manufacturers have demonstrated that glass can be packed to meet this condition. The only thing to do is carefully to pack the product tightly in a light case, such as is successfully employed by our manufacturers in the domestic trade. This case must be enclosed for export in an outside case of strong lumber, made large enough so that an ample cushion can be provided on all sides of the inside case that contains the glass. This cushion will receive the shock of blows, and distribute the impact.

Instead of having the ends and sides of the inside case parallel to the outer one, it is preferable that it should lie diagonally, so that two opposite corners may touch the outside case, and two other opposite corners have an ample cushion. In this manner, it is said, glass can be packed for export to any point along the coast, without the least danger of breakage.

A Searchlight with a Collapsible Tower

DURING the recent review of the newly-organized First Regiment of United States Engineers by Secretary Baker, from the steps of the State, War and Navy Building in Washington, D. C., the searchlight shown in the accompanying illustration took part in the parade.

Not unlike the present-day water tower trucks of metropolitan fire departments, the searchlight is mounted on a steel tower which is normally folded back when the truck is in motion. By an arrangement of steel cables, pulleys and winches, the tower can be readily elevated, so as to raise the searchlight to an appreciable height with respect to the surrounding country. A railed-off platform is provided about the searchlight for the use of the searchlight operator.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Multiple-Unit Selenium Cell of Simple Design

CONSISTING of a piece of copper tubing into which is inserted the bared section of a short length of insulated copper wire, the space between the wire and copper tubing being packed with selenium, the selenium cell developed by R. G. Morgan of East Providence, R. I., is as effective as it is simple and inexpensive to make.

In reality, the selenium cell designed by Mr. Morgan is a selenium unit, for his plans call for the grouping of a number of these minute cells or units into one large cell. Each cell is made by taking a short piece of insulated telephone wire and removing the insulation at one end so as to bare the wire for about three-sixteenths of an inch. This end is then inserted into a copper tube ⅛ inch inside diameter, jamming the insulated part of the wire tightly in place and maintaining the bared section of the wire central to the tube and one with its axis. The air gap thus formed between the copper wire and the inside of the tube is then filled with selenium grains of uncrystallized form, following which the selenium is partly fused by the heat of an alcohol flame.

The sensitive units can now be assembled in a battery, following the general lines of a honeycomb; one side, the positive, of an electric circuit, is connected to all the copper tubes, while the other side, the negative, is connected to the wires. This arrangement, of course, is only followed if the units are to be used in common; for in cases where the units are employed separately, such as in telephoto work, each unit is wired separately.

Through the kindness of Prof. Palmer of Brown University, Mr. Morgan had a number of his selenium units thoroughly tested. Two types of units were submitted for testing, one utilizing fused silicon in granular form packed loosely around the bare wire, and the other utilizing selenium fused in mass within the tube. Prof. Palmer reports that the second type proved most sensitive, and the more important facts contained in his report follow:

All of the first type cells or units were tested with an applied voltage of 248, with an observed current less than 0.2 micro-amperes, indicating a resistance greater than 1,240 megohms. Practically the same results were obtained whether the cells were in the dark or strongly illuminated. Probably a difference between the dark and light condition would be exhibited by more sensitive instruments, but it was judged that the results obtained would not be worth the additional work involved. However, in the case of the second type the results were as indicated below, in which E represents the applied electromotive force in volts, I the observed current in micro-amperes, and R the resistance in megohms:

		Cell Dark		Cell Light	
Observation	E	I	R	I	R
No. 1	97.5	.78	125.0	3.88	25.0
No. 2	133.0	1.75	75.8	4.85	27.4
No. 3	248.0	2.91	85.0	9.70	25.5
No. 4	248.0	4.85	51.0	11.41	21.6
No. 5	248.0	3.30	75.0	9.90	25.0

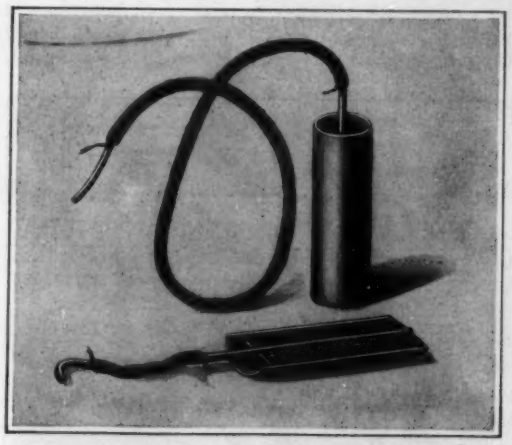
Sunlight concentrated by a lens was used in the first two observations, but the sky was slightly cloudy during the second. The other observations were made with a 60-watt tungsten lamp 3 inches above the cell. Between observations three and four the current was on continuously for about twenty minutes. Between four and five the current was off about four hours. Observations one and two were not made on the same day as the others, and the temperature was probably different on the two days.

None of the cells or units showed any tendency to melt under the action of the highest voltage used, but it is reported that the resistance of one of them gradually decreased when 248 volts was applied continuously. Probably the cells would stand 500 volts continuously without passing more than one one-thousandth of an ampere, and Prof. Palmer believes there would be no danger of their fusing with so small a current. Since one micro-ampere is equal to one millionth of an ampere and one megohm is equal to one million ohms, 95 volts is about the least pressure that can be used unless a highly sensitive galvanometer is available.

A Substitute for the Rifle in Close-Up Fighting

WHEN it comes to close-up fighting under the usual conditions of trench warfare, the modern rifle may well be considered as little more than a wood-and-steel support for the bayonet. Its remarkable precision and magazine features are of little value in the limited space in which this phase of battle takes place; and the decision rests with the side that is most skilled in the handling of the bayonet. The automatic pistol, however, is said to be a most effective weapon under such conditions, and together with the bayonet it would seem to point the way to the ideal weapon for close-up fighting.

What appears to be a practical effort along these lines is presented in the trench weapon devised by an English-



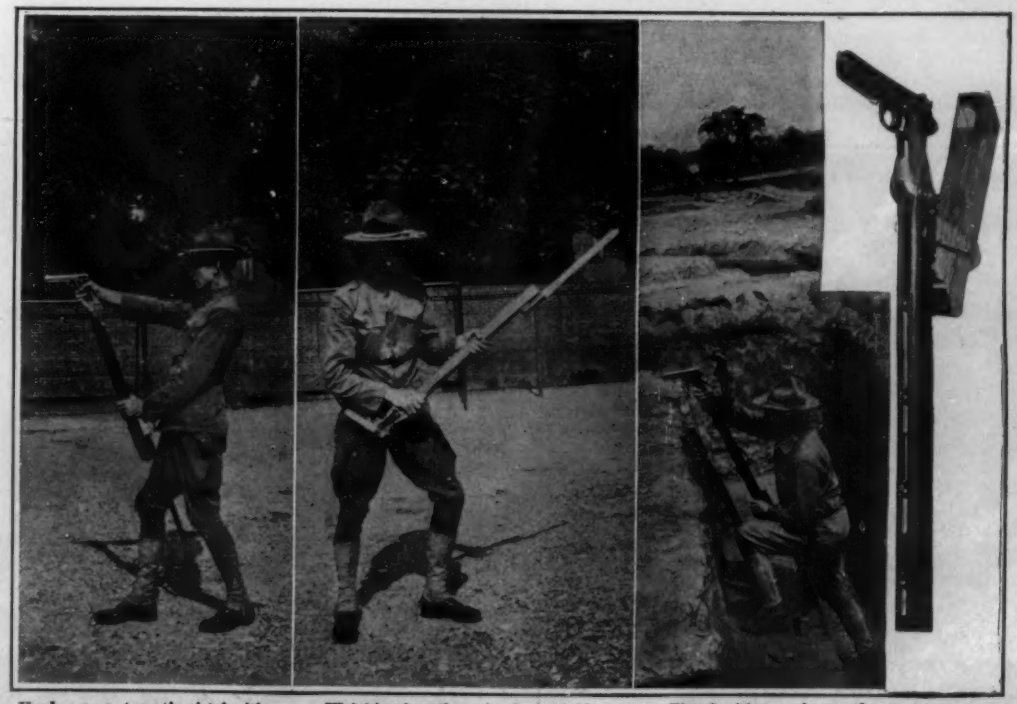
This selenium unit may be readily made by anyone. A number of such units can be grouped together to form one cell

man, Charles J. Cooke of Washington, D. C., consisting of the conventional automatic pistol, a holder for several magazines in addition to the one in the pistol, and a conventional bayonet. It will be noted in the accompanying illustrations that the pistol is clamped at one end of the wooden magazine-holder, while the bayonet is held in place at the other, so that either weapon may be brought into play by the user. Briefly, Mr. Cooke's plan is to make a sort of machine gun of the usual automatic pistol, and to provide an adequate support for the usual bayonet.

The magazine-holder consists of a hollow handle in which four or more magazines are held in place after being inserted through the upper or widened portion of a slot that extends down the front face. The magazines are held in place by metal strips which border the slot, commencing some distance down from the top, as well as by spring-actuated blocks which press against each magazine. The automatic pistol is held in position at the top of the magazine-holder by a suitable clamp, which can be instantly opened so as to release the fire-arm should one wish to use it as a regular pistol.

In operation the topmost magazine in the holder is pushed up into the magazine of the pistol by a quick, upward movement of the index finger of the left hand, passing through the slot in the magazine-holder. The seven rounds contained in the magazine having been fired, the usual ejecting spring of the pistol is actuated, releasing the empty magazine which drops into the magazine-holder only to strike a projecting trip that causes it to fall out, clearing the way for the next magazine which is then pushed up into place. The action is continued in this manner until all the magazines are exhausted, whereupon five fresh magazines can be inserted in the magazine-holder. This later operation requires but a few seconds and is so simple that it can be performed in the dark.

All of which means that the new trench weapon gives its user 35 or more chances of disabling his antagonist with 45-caliber bullets, and the usual bayonet to fall back on if the combat is to be decided by "cold steel." The weapon, according to the inventor, weighs somewhat less than the Springfield rifle; and while it is possible to make the holder long enough to contain seven magazines, he prefers to limit the capacity to five so as to keep down the weight. As a further refinement Mr. Cooke has devised a simple periscope attachment which makes it possible to use the pistol without exposing one's body when shooting over the top of a trench or around a corner.



Used as an automatic pistol with a 35-round magazine in reserve

Weighing less than the Springfield rifle, it makes an excellent bayonet holder

Fitted with a periscope the new weapon can be used without exposing one's body

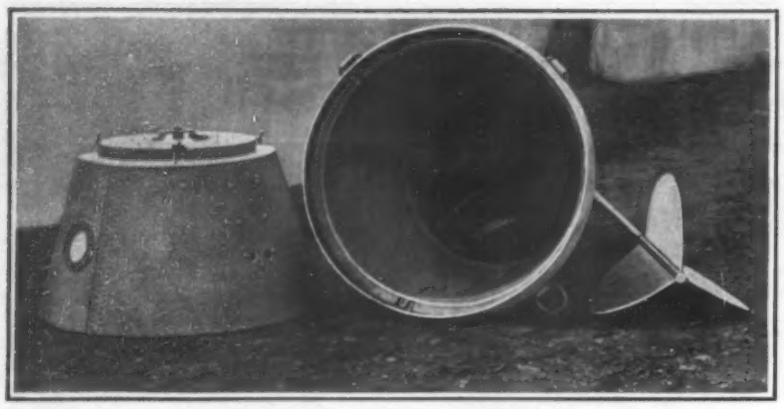
Various uses for the recently-invented trench weapon which combines the automatic pistol and bayonet into a single instrument

New Method of Separating Fine Metal Borings

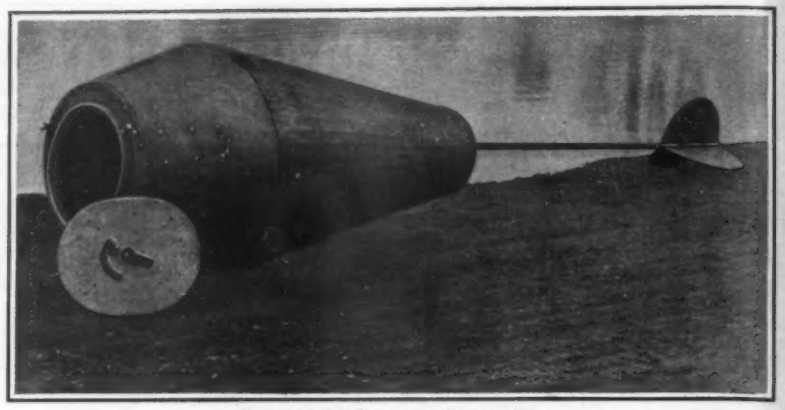
IN these days of great waste of many materials, any method of saving metals that were formerly discarded is worthy of serious attention. Fine gun metal and white metal borings are often found as a mixture and as such are of little value. But a new method of separating them comes from the chief chemist of the New South Wales Railway Department. It is as follows:

The old method was by liquation on an iron plate or in a furnace, which was satisfactory for coarse borings but quite useless for fine grades. The problem of the removal of the white metal in the fine borings has been solved. The small borings are passed to a magnetic separator picked up by a revolving belt fitted with pockets, and conveyed to an overhead bin, whence they gravitate to classifiers, and are separated into three grades. From bins Nos. 1 and 2, containing the coarser material, the borings gravitate on to a short revolving belt, fitted with pockets, and are delivered into a bin above the furnaces. These furnaces are constructed of iron tubes, one fitting inside the other. The outer one, being several inches larger in diameter than the inner, is supported by means of brackets to the floor, and carries in the intervening space between the two tubes a coil of iron pipe, with suitable sized perforations for heating the walls of the inner tube with gas. The inner tube revolves, and the hot borings and liquid white metals pass into revolving screens, smaller in mesh than the last classifier and the liquid white metal escapes through the screen into an outer surrounding vessel, heated by a gas coil. In this way the white metal does not cool, but collects at the bottom and can be run into molds.

The clean borings pass along the screen on to a hand truck on wheels, and are taken to the foundry, melted, and used for ordinary gunmetal castings. Each grade is treated separately.



Interior view of the upright life buoy



The new life buoy awaiting a test

Life-Boat or Life-Buoy

SOONER or later we must face the fact that the life-boat is an inadequate measure of protection for the passengers on the modern ocean liner. While vessels have greatly increased in size within the last quarter century, the means of launching life-boats has remained practically the same. A boat can be lowered a few feet with some degree of safety; but to lower it the great distance necessary on ships like the "Titanic" and the "Lusitania" is practically impossible without the lines tangling or the boat crashing against the vessel's side. Moreover, a sinking vessel has evidently one or several serious leaks; and with water pouring into some of her large compartments her stability is at once destroyed. How many times do we read in the account of a maritime disaster something like this: "Owing to the location of the rent in her side, the ship listed heavily to port. The boats on that side were launched with the greatest of ease; but with the starboard slanting at an angle of some twenty degrees it was out of the question to get the boats free on that quarter." In such instance, which it must be emphasized is the rule and not the exception, there are not enough boats available to accommodate passengers and crew; consequently the boats that are got away are overcrowded, and one or more of them is almost certain to be capsized, or even swamped.

In these days of wireless communication, when vessels are constantly in touch with a number of other craft, every vessel may well be equipped with floaters of some sort which could be launched with rapidity while the vessel is still in motion and which, if required, would free themselves in case of the vessel sinking rapidly. The buoy illustrated herewith is a floater par excellence. Not only does it float right side up in any sea, but it keeps its occupants sheltered and comfortable in the coldest water and weather. It is built of galvanized iron, heavily reinforced, carries three passengers with food and water for a week, an electric flashlight, and signal rockets. It is built to be absolutely fool-proof, and its cost per passenger is trifling in comparison with that of life-boat or raft.

An Automobile Headlight That Is Provided With A Visor

FITTED with a visor which is enameled green on the outside and white on the inside, and arranged much after the fashion of the human eyelid, a recently-introduced automobile-headlight lens is certainly unique.

By means of five horizontal prisms, each of which is inclined at an angle that was determined with scientific accuracy, the new lens directs the light down, below the horizontal, lighting the path of the car at the greatest distance possible without having the glare of the lamps blind the driver in an approaching automobile. The concave recesses in the back of the lens spread the light laterally, thus providing the essential side lighting necessary for country driving and for turning corners.

Contrary to the claims of certain lens manufacturers, the present lens, according to its designer, does not add to the volume of light. While it has the appearance of doing so, due to the increased illumination of the road,

The life buoy in position ready for action

what it actually does is to utilize all the available light by directing it so that the driver obtains a clear view of the road ahead. At the same time the driver of a car coming in the opposite direction is not blinded, since the light is confined to the road and there is no glare.

Tire and Tools In the Same Place

EVERYBODY has seen the circular automobile trunk that goes inside the spare tires. But we do not always take a trunk when we go automobiling; so it would seem reasonable to inquire whether this clever bit of packing could not be applied to better advantage. The Philadelphia man whose invention we illustrate has reasoned that the one thing we must always have on the car, whether we are going around the block or across the continent, is the tool-box. So he has made his tool-box round and flat, and has fitted it neatly inside the extra tire, at once effecting a saving of space and getting the tools in the one place in the whole car where they are most accessible when we want them.

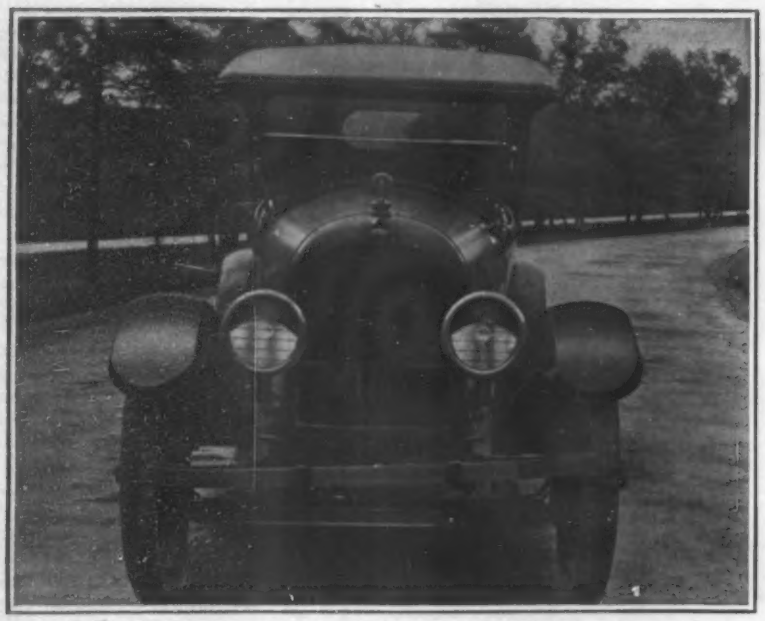
The tire is held firmly at three points by straps attached to holders firmly secured to the running board. When placed at the rear of the car, the combination tire-holder and tool box is carried on two angle irons bolted to the under framework of the chassis, with ample vertical and horizontal bracings. The operations of tire removing and replacing are ridiculously easy, and the tools fairly fall out of the chest at the owner's call. The tool chest is made in two compartments, one of which will come in handy for carrying lunch, etc., on short trips. Under ordinary circumstances this extra compartment is available for waste, cleaning materials, and the various articles which the tidy motorist does not like to have at large in his tool chest.

Asbestos-Cement Sheets as a Substitute for Corrugated Iron

THE British, in their efforts to practice economy in the use of steel and iron of all kinds, have developed and are now manufacturing a satisfactory substitute material for corrugated iron and sheets. It is an asbestos-cement roofing material. In the last year a large plant has been built in England and equipped for manufacturing this product. It is made as follows:

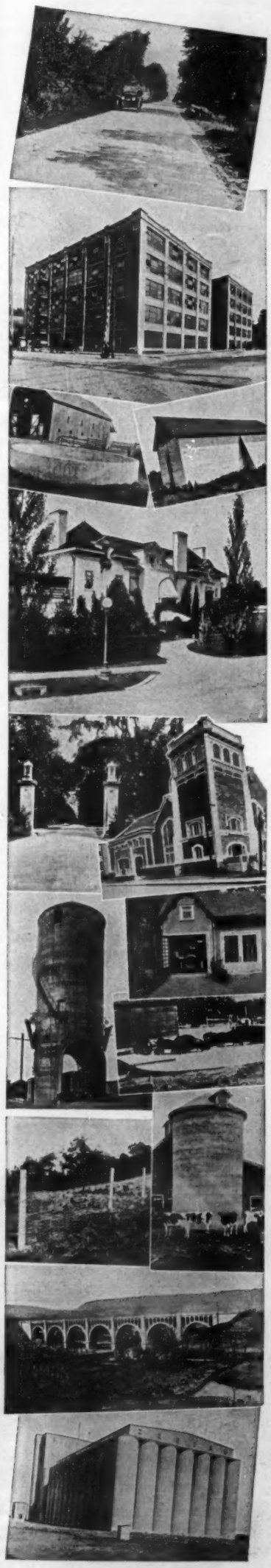
After being finely ground and freed from extraneous matter the asbestos, which acts as a reinforcing agent, is mixed with Portland cement in the proportion of about 1 to 6, and made into a kind of paste with water. This paste is then taken to a machine of the paper-making type where, on a large revolving drum, it is formed into sheets or felts. After being trimmed to size these sheets, if they are to be made into corrugated roofing, next have the corrugations impressed on them, the important condition of this operation being to insure that the tops of the corrugations are as strong as other parts of the sheets. Finally the sheets are subjected to a seasoning process. The corrugations are made to the 3-inch pitch which is usual with corrugated iron sheeting, not to the 2½-inch foreign pitch, and they can therefore be readily used to repair roofs composed of corrugated iron sheets.

One of the chief advantages claimed is durability and resistance to climatic conditions, especially to an acid-laden atmosphere, which rapidly destroys corrugated iron. The sheets are also fireproof and poor conductors of heat. The factory is well situated as regards supply of water, of which large quantities are required. The machinery is driven by electricity.



Provided with a green enamel visor, these headlight lenses are non-glaring and highly efficient

The combination automobile tire and tool-holder showing position when in use



Now is the Time to Use

CONCRETE

War Bulletin No. 2, of the Chamber of Commerce of the United States, says:

"Iron and steel should be used only when the requirement is unavoidable. Every effort should be made to use wood and concrete in place of steel whenever this can be done, and construction and development work requiring steel should be postponed wherever possible . . . . cement may be had in quantity for concrete work."

Says Cass Gilbert, the New York architect:

"There are hundreds of buildings erected in this country every year which could be just as well erected without steel, and in hundreds of others the amount of steel could be greatly reduced. An enormous tonnage could be saved if reinforced concrete, masonry or other materials were used. Practically all buildings of moderate height can be erected without the use of large quantities of structural steel. Reinforced concrete or old-fashioned masonry can take its place."

Under present conditions concrete is particularly desirable. All the materials—portland cement, sand, pebbles or crushed stone—are staple products, most of them obtainable near by. Concrete is made with ordinary labor under skilled supervision. Concrete contractors have developed rapid and efficient methods of construction. There are many engineers, architects and contractors who specialize in concrete construction. If necessary we can help you get in touch with them.

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RECENTLY PATENTED INVENTIONS

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Pertaining to Apparel

PROTECTIVE LINING FOR GARMENTS.—M. I. GREENBERG, 112 Madison Ave., New York, N. Y. This invention is an antiseptic "protecto-slip" which is to be attached with a seal to the linings of ready-made gowns and blouses in such manner that the real lining of the

PROTECTIVE LINING FOR GARMENTS

gown never comes in contact with the persons who try on the garment. The seal remains unbroken until the garment is sold. When the slip is removed the one who buys the gown has the satisfaction of knowing that the lining has come in contact with no one else.

Of General Interest

LOOSE-LEAF BOOK.—J. W. MYATT, Tipton, England. The invention relates to loose leaf-books or binders of the type in which telescopic members are employed between a pair of clamping bars for the attachment of the leaves, the object being to provide a construction which permits a greater extension of the members than those usually employed. The invention comprises three or more telescopic members and an internally arranged cable enlargements being provided on the ends of the cable to limit the extensibility.

ATTACHMENT FOR PENCILS OR PENHOLDERS.—A. C. NEWMAN, Box 452, Fargo, N. D. This inventor has obtained two patents for novel calendar attachments to be slipped onto a pencil or penholder. In one as illustrated a strip is wound on a spool which is of rubber presenting resilient flanged heads overlapping the side edges of the strip, the latter bearing the days of the month. The strip is scored transversely between the months and formed with notches at the ends

A PERSPECTIVE VIEW OF ATTACHMENT AS APPLIED TO A LEAD PENCIL

of the score lines so that the successive sections of the strip may be readily torn off. In another form the spool includes an inner split sleeves for clamping the inner end of the strip and has a shell presenting a side opening to expose the calendar months. The outer end of the strip is passed through slots in the shell to frictionally hold it. In the latter form also the shell has the initials of the day of the week in reverse order so that the attachment may be disposed with either end forward.

MECHANICAL EYES.—P. C. JACQUEROD, 597 Madison St., West New York, N. J. An object of the invention is to provide mechanical eyes which are adjustable; in which the distance between the eyes may be varied so as to make them adaptable for various toys in which the distance between the eye openings is variable.

MILK-BOTTLE HOLDER.—C. AUER, Fragaria, Wash. The invention particularly relates to a milk-bottle holder in which a catch is utilized for preventing a reverse movement of the bottle carrying member the catch being associated with a spring. A further object is to provide a holding device which is connected to the door jamb in such a way that the securing means are covered in a manner to prevent the operation of the device by an instrument.

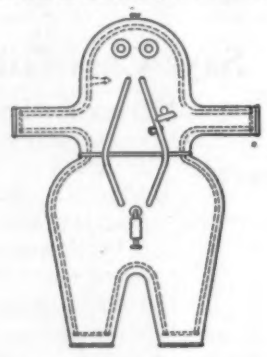
STREET AND STATION INDICATOR.—J. W. DILLEY and J. F. COOK, 2,220 Cabell St., Dallas, Texas. This device is adapted to be displayed in a car at a point plainly in view of the passengers for the purpose of announcing or exhibiting the names of stations or street crossings along an electric or steam railway as the car approaches the station or crossing, also for exhibiting the names of business firms or advertising data.

SHIP FLOATING DEVICE.—S. SUZUKI, 2,204 Quincy Ave., Ogden, Utah. The object of the invention is to provide a means for raising ships or other objects by connecting inflatable bags. Fastening means are provided which prevent water from passing between the bags, there are also means which permit the inflation of the bags with air. The interior of each bag is connected with the interior of the neighboring bags by means of pipes. The bags are secured to longitudinally extending chains at the sides of the ship.

COMPUTING-SCALE.—A. BOQUET, address Henry M. Bourg, Homna, La. An object of this invention is to provide an index arm or pointer by means of which the tare weight of a container is registered when the container is placed on the scale pan, thereby obviating the necessity of shifting weights to balance the container in order to fill the container with a given net weight of a commodity. A further object is to provide means by which the net weight may be indicated and the selling price instantly observed.

REGISTER.—A. W. PRESCOTT, 207 Water St., Binghamton, N. Y. The invention has for its object to provide a form of supporting frame for the louvers and a form of face plate or grill so arranged that the connection between the grill and the supporting frame will be concealed, and wherein the operating mechanism for opening and closing the louvers is mounted upon rollers for movement in a single plane and wherein the mechanism is connected to the louvers in such a manner that the pull on the louvers will be approximately perpendicular to their planes.

COMBINED LIFE-PRESERVER AND DIVING-SUIT.—C. S. ALTOONIAN, Providence, R. I. The object is to provide a combined life preserver and diving suit which shall be simple, easily applied and will be thoroughly effective in support-

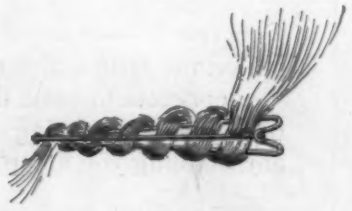


FACE VIEW OF COMPLETE INVENTION

ing the weight of a human body in the water, and when necessity compels may be brought to a condition in which the user will be effectively guarded against danger of drowning under any but very exceptional circumstances. A further object is to provide a suit which requires no connection with surface while the wearer is under the water, as the diver is provided with the necessary supply of air. The suit could be used by life savers saving the life of a drowning person, or by firemen to protect their bodies from heat and from smoke.

ANIMAL FEEDING DEVICE.—T. FOUTS, Mapleview Farm, Camden, Ind. The invention is an automatic feed regulator, permitting the self-feeding of animals, wherein a feed regulating plate is provided for connection with a bin or the like having a lateral opening and connected to the bin in such manner that the width of the feed opening may be varied, together with a retaining plate for preventing waisting of the feed.

HAIR-CURLER.—J. W. CHAMPION and O. BERGE. Address Arthur A. Kugler, Atty., Osage, Iowa. The patent relates particularly to a simple and inexpensive curler formed of a single piece



PLAN VIEW ILLUSTRATING PRACTICAL APPLICATION OF CURLER

of wire as shown, the object being to provide a curler which will be effective and efficient in use for the purpose of curling and crimping the hair, which may be readily manipulated and which will be strong and durable.

DOLL.—F. B. SCHULTZ, care of Papier Mache Works of America, 117 Spruce St., New York, N. Y. The invention relates to dolls and deals particularly with means for joining the arms, legs and head to the trunk, the general object is to so simplify the construction that persons of ordinary skill can readily repair the doll. A more specific object is the provision of a joint between the members of the doll and the trunk, the joint involving an elastic band, and engaging with the ends of elastic loop are button-like fasteners.

SAFETY RAZOR.—W. J. MYATT, Birmingham, England. The invention has for its object to provide means for adjusting the blade relatively to the usual guard. A range of adjustment is obtained which enables the user to set the blade to suit his particular requirements. At the rear of the guard is pivoted a spring controlled movable clip which extends along the back of the guard and is adapted to engage the rear edge of the blade.

Household Utilities

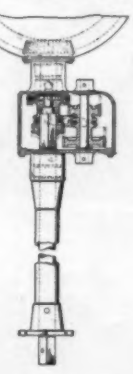
DINING-TABLE PLATE-HEATING APPLIANCE.—W. W. KUHLMANN, 124 29th St., Woodcliffe-on-Hudson, Guttenberg, P.O., N. J. This invention relates to a plate-warming appliance adapted to be used on a dining-table, for

PLATE HEATER

the purpose of keeping the plate warm while the diner is eating, its general object is to provide an appliance the character of which is of comparatively simple and inexpensive construction, reliable and efficient in use, and of neat and attractive appearance.

Machines and Mechanical Devices

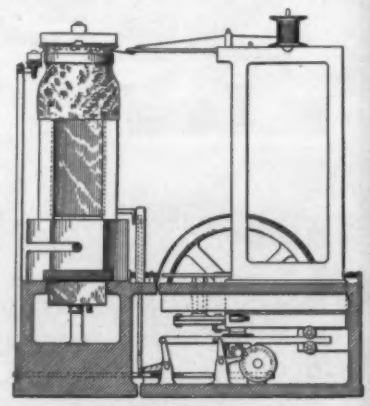
GEARING.—M. S. BROWN, care of Brown-Parker Auto Co., Goldfield, Nev. The invention relates more particularly to a transmission to be used in connection with automobiles which are already equipped with means for driving the rear



GEARING

axle at two or more speeds, the object is to provide an auxiliary gearing to be used in connection with the ordinary transmission gearing whereby the number of speeds at which the car may be driven is multiplied two-fold.

DARNING AND WEAVING DEVICE.—C. M. FYFE, 1852 70th St., Brooklyn, N. Y. The invention relates to a device for darning or weaving, and more particularly to a machine which is intended to be operated by hand or as an attachment to a sewing machine; another object of the invention is to provide a daring



DARNING AND WEAVING DEVICE

device which is comparatively simple, and so designed that darning can be quickly accomplished without any special skill on the part of the user. After the work is applied to the holder the needle threaded, and the parts properly adjusted, the darning operation is performed by simply turning a crank.

Pertaining to Vehicles

AUTOMOBILE SIGNALING DEVICE.—G. M. DUCAS, 50 Courtlandt St., Bridgeport, Conn. The invention relates to a signaling apparatus especially adapted for automobiles for indicating to the drivers of other automobiles or to pedestrians the direction in which the automobile is to turn, or the fact that it is to be stopped, the indicating devices, during the day are unilluminated and at night are illuminated.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

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The Neglected Water Power of New England

(Continued from page 129)

Harriman, in predicting the substitution of electric power for steam on our railroads, named the Boston and Maine as one of the first roads where the metamorphosis would take place. On hundreds of New England farms power now being derived from gasoline engines and the like will undoubtedly be taken from harnessed water courses. An electric motor calls for much less expense than a gasoline engine; and by coöperation the farmers could even use the larger brooks.

There has just been established at Somerset, on the Deerfield River, the largest storage reservoir in all New England. Its dam, more than 2,000 feet long and 100 feet high, will hold back for distribution the spring freshets that annually pour down from the Canadian watershed. Its storage supply will inundate a broad mountain valley. Its control over the river's flow to the hydro-electric stations below will be felt in mills and factories, on street car lines and railroads, over a wide radius.

This big dam, brought to completion with little or no flourish of trumpets, practically unknown except to the experts immediately concerned, has a basin which will hold more than twenty-three billion gallons of water. It is of the type known as earth dam—a huge ridge of earth, far wider and of much gentler slope than the ordinary masonry dam—and its construction has involved much ingenious patience and the combined labors of 500 men, 10 locomotives, 100 cars and a battery of steam shovels. Two high railroad trestles were thrown temporarily across the valley and from these, mountains of earth were dumped so as to form two long, sloping parallel banks. Powerful streams of water were then brought to play against these banks in such a way that the earth was washed bodily into its final resting place between the dumping lines. Saturated with water and driven under pressure, the finer earth thus was forced into the middle of the mass, and formed a substance more impervious than clay. As the dam rose in height the lines of trestle were brought closer and closer, until they almost joined. A mile and a half in length and higher than a ten-story building, in a year the Somerset dam will probably be so overgrown with underbrush that it will resemble a natural formation.

Simultaneously with the erection of this huge earthen barrier, there has been put up a group of four large hydro-electric power stations on the river below. From Somerset to Greenfield, Mass., where it joins the Connecticut, the Deerfield River drops some two thousand feet. More than half of this fall is easily available for hydro-electric development, and is now controlled by a single corporation and its allied interests. Near Shelburne Falls three huge concrete dams of the ordinary type have been thrown across the river, and three duplicate power houses set up, each containing a set of generators with capacity of 8,000 horse-power. Three miles above the famous Hoosac Tunnel a fourth dam and station are nearing completion. It is expected that this will add 80 per cent to the capacity of the plants below.

But these important projects are only a part of the water power activity that is stirring in New England. Five years ago 75,000 volts were turned on from Vernon, Vt., marking the completion of the great two-million-dollar dam at Hinsdale, N. H., and Vernon. That huge structure, which at the time constituted the largest electrically developed power unit in New England, collected the waters from a drainage area of 6,000 square miles. It has created an artificial lake 16 miles long, with a total storage capacity of two hundred million cubic feet. Under a huge system of dams and basins the resulting energy of more than 50,000 horse-power is being distributed throughout the territory from Keene, N. H., to Brattleboro, Vt., and from North Adams to Marlboro, Mass.

The best part of the latter State is grid-

(Concluded on page 146)

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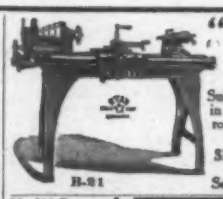

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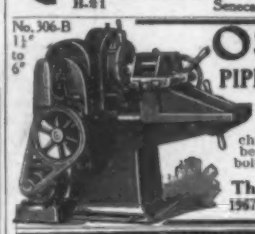

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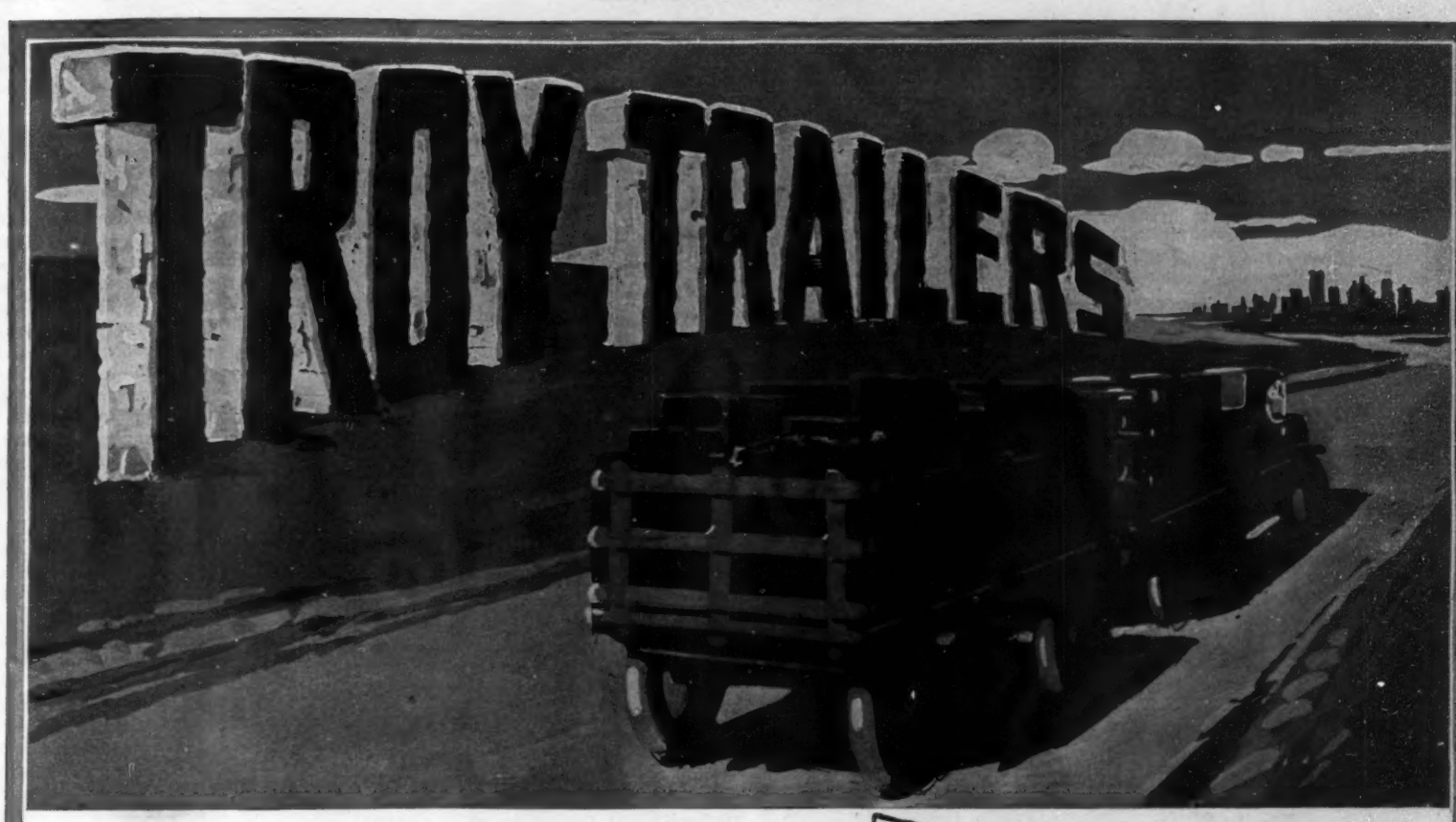

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Under average conditions your truck can carry its full rated load and at the same time pull as much or more on TROY Trailers.

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The largest concerns in the world no longer base the hauling of their trucks upon their trucks' carrying capacity alone. We have shown them how, by using Troy Trailers, they were able to deliver loads at least two times greater than with their trucks alone. And all this increased efficiency at the insignificant increase in maintenance cost of not more than 10%.

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"Increases capacity of our trucks from 60 to 70 per cent."

O'Reilly Storage Warehouse Co.
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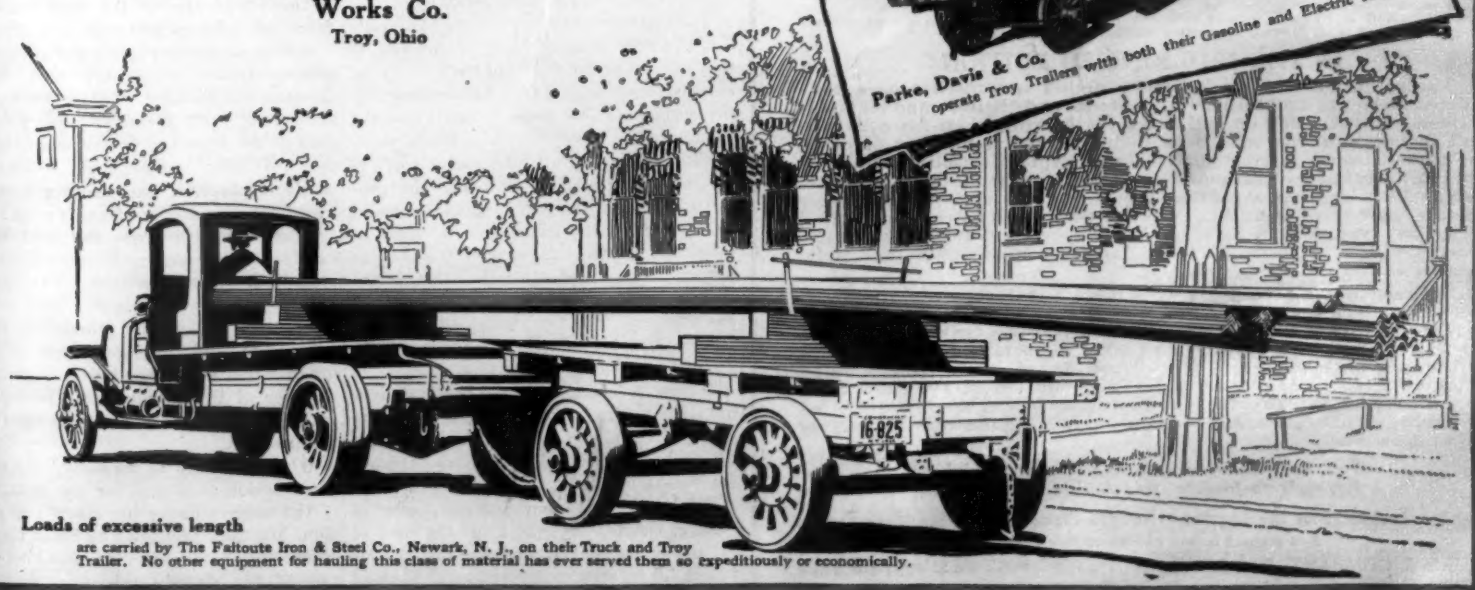

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are carried by The Faitoute Iron & Steel Co., Newark, N. J., on their Truck and Troy Trailer. No other equipment for hauling this class of material has ever served them so expeditiously or economically.

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Is still the governing factor in production. With thousands of men drafted to the colors and munition plants, you will be forced to raise and conserve the physical standard of your labor and meet the shortage by increased efficiency.

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Employes find the comfortable, resilient nature of this floor a great preventive against the fatigue that attacks them when standing all day on hard, cold floors. This means more and better work. Trucking requires less effort because the surface of the floor is permanently smooth even under the heaviest wear. It is warm, dry, dustless and a non-reflector of light.

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IN THE 1916 REVISED EDITION

The subject of electrical motor starting systems has been considered at length and all leading systems and their components described. A discussion on ball and roller bearing, their maintenance and installation, has also been included, and a number of other features of timely interest such as latest types of gasoline and kerosene carburetors, cyclecar power plants, the Fischer Slide valve motor, detachable wire wheels, cantilever springs, eight and twelve-cylinder motors, new valve operating systems, Stewart-Warner vacuum fuel feed, boat type body design, leather universal joints, Entz electric transmission, positive differential, armored automobile, hydraulic brakes, etc.

Entirely new material has been added on tractors in three and four-wheel forms, cyclecars and agricultural tractors or automobile plows; combination gasoline-electric drive, front-wheel and four-wheel drive and steer systems and other important developments in power-propelled vehicles. The discussion of power transmission methods has been augmented by consideration of the skew bevel gear and two-speed direct drive rear axle, as well as several new forms of worm gear drive, etc., have been added to bring the work thoroughly up to date.

This book is superior to any treatise published
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Not too Technical for the Layman—Not too Elementary for the More Exptre

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MUNN & COMPANY, Inc., 233 Broadway, Woolworth Building, New York

The Neglected Water Power of New England

(*Concluded from page 144*)

ironed by these wires, while other lines are planned to cover southern Vermont and New Hampshire, northern Connecticut, and even Rhode Island. At the present time a high tension main transmission line is in operation from Shelburne Falls via Ware and Millbury to Worcester, thence to Fitchburg, Gardner and Brattleboro, and back to the starting point via Hinsdale. This loop is continually being expanded. From North Adams a line is planned to run north to the cotton and woolen mills of Bennington, and another southward to those of Pittsfield. From Uxbridge an extension is projected to reach Providence and Pawtucket, in spite of the competition afforded in those cities by tide-water coal. From Fitchburg a third line will run to the mills of Nashua and Lowell.

In this way the hydro-electric engineer is steadily putting his network over all New England. The only serious competitor which he has in his field is the tide-water coal just mentioned. Boston, for example, secures its industrial coal at $3.50 per ton, and at this figure can develop its own electric power at somewhat lower cost than that of bringing in the current from the Connecticut Valley. But even if this should be a permanent disadvantage, it is not sufficient to keep the natural power from claiming its rightful place. The vital element is that the State Commissions of the various states are giving concerted and systematic investigation and publicity to the subject. Manufacturers, investors and engineers are being brought to careful consideration of a theme that has hitherto escaped them. All in all, New England's adequate development of her natural power resources, if slow in coming, seems now to be correspondingly sure.

Gas Engine Drive for Submerged Submarines

(*Concluded from page 132*)

Aft, the suction of the big engine draws the air to its intake, creating a steady draft through the boat. The amount used by the engine is of course far in excess of the needs of the crew, and the men therefore work in a constantly renewing air supply. The air supply turned into the boat is regulated by the demands of the engines, the pressure is kept at about that of the atmosphere.

The engine exhaust, after serving to heat the air from the tanks in the before-mentioned reheating device, is passed into a water-cooled condenser outboard, where it is cooled and contracted. Then it is drawn into the cylinders of the exhauster and driven out of the boat through a clam-shell valve opening close to the keel.

There is, therefore, an excess of fresh air in the boat at all times, instead of the stinking, dead atmosphere of oil particles and battery gas and evil smells. No gas or dead air pockets can form with the steady draft through the hull of the boat. Mal de mer is largely done away with.

The military advantage of the plan, outside of the greater efficiency of the crew, is that instead of the power of the boat being reduced from say 1,000 horse-power on the surface to 500 horse-power when the change to the electric drive is made, practically the full power of the engine remains available. Instead of reducing the propeller size from the standard which would be correct for the gas engine in order to temper it to the weakness of the storage battery, the propellers are left the correct size for the thews and sinews of the mighty gas engines. The boat develops the same power, and almost the same speed submerged as when on the surface.

Where the storage battery would deliver not to exceed an hour's run at the maximum speed of 10 miles per hour, the gas engine driven boat can develop 14 miles per hour for two hours.

When the question becomes one of loafing, the battery has a bit the best of it—but of course the condition of the crew is not taken into consideration at the end of the time. Where the air tank installation now contemplated permits the boat to cruise 11 hours at 5 knots, the battery-driven boat can cruise 15 hours at the same rate. Alteration of design and the utilization of every possible bit of room for the tanks would lengthen this time and also add to the time the boat could maintain its maximum speed.

The Navy submarine man, shown the plan of this type of engine, invariably spots as the Ethiopian in the wood pile the possibility that the presence of the boat might be given away by a wake of gas and oil bubbles. Needless to say if a submarine goes around very long leaving a neat little trail of gas bubbles and oil slick, some tickled submarine chaser will alight on the scent, cruise along to leeward with the 3-incher cocked and primed and be right on the job when the shark sticks out its dorsal fin. Also there is the matter of noise.

To this Mr. Neff replies as he replied to the Congressional Committee, that the exhaust is sent out of the sea-valve at a pressure little more than that of the water, and there is no characteristic noise of exhaust to give away the boat. Furthermore the noise is merely the common reciprocating murmur of the engines used by most surface craft, and the high pitched whine of the electric motor, to which the microphones of the submarine chasers are attuned, is absent. A possible one of the many rich jokes Fritz will have to spring after the war is that of the latest German submarines sliding under the keels of chasers who are listening only for the whine of electric motors, not the murmur of the gas engine.

The exhaust gases, after being cooled and condensed, are driven out of a clam-shell valve in the bottom of the boat and forward of the propellers. The rush of water into the forward end of the valve sprays the gas and it is taken by the rush of water along the bottom to the pound of the propellers, where it is beaten up much as the egg is beaten up in the whirling egg beater. The gas does not issue under pressure, and it is thoroughly mixed with water.

The board sitting in the case of the California experimental submarine stated that it didn't notice any perceptible wake to the Cage submarine when it submerged.

The displacement wave of any submarine is perceptible in smooth water, and there is also a white, milky wake from the propeller beat releasing air in the water. The sole difference in the wake of the gas engine boat will probably be merely a slight increase in this milky appearance. In water rough enough to hide the displacement wave this wake is not visible; in water smooth enough to show the wake, the displacement wave is a far more accurate index to the whereabouts of the boat.

A possible variation of the air tank plan, is the addition of tanks filled with pure oxygen—stated also to be used by the Germans. The exhaust is rid of its moisture and its oil, is mixed with oxygen from the tanks, and is used over and over again. The crew of course use air from the storage tanks.

The advantages of the Neff system of drive, summed up are:

Higher submerged speed and consequent greater power of attack and escape. Greater habitability of the boat when submerged, with greater efficiency on the part of the crew and greater endurance in case of long submersion. Absence of costly, short-lived and delicate batteries. Freedom from danger of gassing, and from spilling of acid in case the boat should capsize temporarily. Economy of installation. Lesser weight. Far greater ability to keep the sea for long periods because of the greater durability of the gas engine, and the short time necessary for overhaul when that becomes desirable. Absence of the characteristic motor hum which plainly marks the passing of the submersible.

Work will start at an early date on the construction of a boat for the installation of the engines under the Navy appropriation, Mr. Neff preferring to build the boat complete, to the Navy's scheme of using one of the already existing submarines, with the high cost of making the changes

necessary according to the Navy figures. The new boat will be of course entirely experimental, but the machinery that goes in will be tested units selected after careful consultation with the greatest firms making them, from the makers of the air compressors to the builders of the engines. If the plan is a failure, it will be because of some unforseen objection, not because of any weakness that the makers of the apparatus required could foresee and prevent.

The War of Specialists—The Machine Gunner

(Concluded from page 137)

and a few well wired in will hold up a division, the necessity of locating the enemy's guns and concealing your own must be apparent.

Machine guns are best used from innocent looking positions with good field of fire, such as hay cocks, behind timber, growing crops, bushes, hay ricks, bundles of sticks, etc.; that is to say, from positions which are not obviously placed where you would expect them. They are essentially weapons of opportunity and surprise. "Concealment is the best protection." In the N. W. corner to the Grand Place, Ypres, there is a shell hole which measures 50 feet across the mouth of the crater and 22 feet deep in the center, caused by the arrival of a 42-centimeter shell (about 17½ inches) on a hard pavé road. In another we buried thirty horses. This will show the folly of trying to build up anything strong enough to protect a machine gun from shelling. Of course emplacements are made to withstand small shells, shrapnel and bullets; but every inch put on will make an emplacement more conspicuous and any heightening above the line of a trench will be shelled; therefore I cannot repeat too often "Concealment rather than protection."

Lewis guns are distinct weapons from machine guns and are used by the infantry, and in the front line work they go over with the second and later waves. They are inconspicuous, can be carried easily, and look at a distance like rifles. The rate of fire is quicker and more concentrated than that of a machine gun. The 47 cartridges contained in a drum are fired at the rate of 780 a minute while the gun is firing; but it is impossible to maintain that rate of fire, time being lost through the drums having to be changed.

Lewis guns are new weapons and are as distinct from machine guns as a revolver is distinct from a rifle, their only similarity being that they fire the same caliber ammunition.

Machine guns produce a narrow, dense cone of fire, therefore they should be used to a flank, fired obliquely, and fired to the front only when a favorable target appears. A bullet from a machine gun will hit a man, and hit him again ten times as he is going down; but in the case of a gun catching men obliquely you always have a target of fresh men. Machine gun training must play an important part in all new armies, and it is only the cool, reliable man with a thorough knowledge of his work and weapon that can get results. A man must know his gun as a keen motorist knows his car or a jockey his mount. The old idea that you wait for your enemy to show up in numbers, open fire, and then expect them to keep on coming, is wrong. Your work will be over in a matter of minutes and seconds and then you will have to move. On one occasion a machine gunner operating from second stories in village fighting changed his position six times, only firing five minutes from each place. In every case, inside of fifteen minutes from the time he had opened fire, the houses were shelled.

A rush of men may get past a gun, but not if it is enfilading a barbed wire or obstacles, and correctly handled. A gun in action enfilading 500 yards of wire is worth a man a yard.

Starch in Santo Domingo

STARCH is made in Santo Domingo by the peasants throughout all the Cibao region from the yuca or manioc root (*Bot. Jatropha manihot*) by a process of squeezing out the juice and then drying it.

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Try this Test:—Rub a little Tuxedo briskly in the palm of your hand to bring out its full aroma. Then smell it deep—its delicious, *pure fragrance* will convince you. Try this test with any other tobacco and we will let Tuxedo stand or fall on your judgment—

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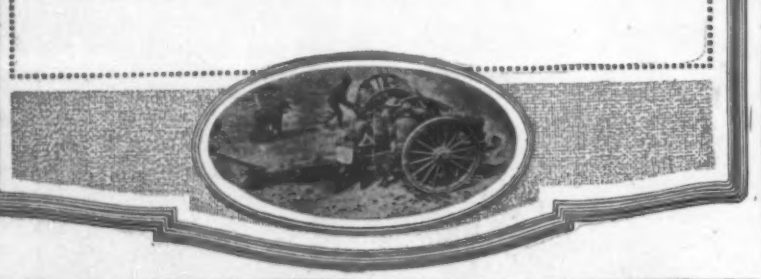

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We shall be pleased to give our unbiased, free opinion as to the probable patentability of any invention, provided a sketch and a description disclosing the same are sent to us. A distinct advantage possessed by our clients is found in the notice which each patent taken out through our office receives in the *Scientific American*.

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FOREIGN COMMERCIAL NOTES AND QUERIES

The SCIENTIFIC AMERICAN has always enjoyed a wide international circulation. Its voice is heard in the remotest corners of the earth. Now that American manufacturers have been stirred to the advantages of international expansion we are anxious to do our part in bringing American products into foreign markets. Hence this department has been established to pave the way for American trade expansion to all quarters of the globe.

Those who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The SCIENTIFIC AMERICAN assumes no responsibility for the financial standing of concerns or individuals. Address all communications to the Query Editor of the SCIENTIFIC AMERICAN, Woolworth Building, New York.

627. An agency is desired by a man in France for the sale of small tools for ammunition factories. Payment will be made against documents. Correspondence should be in French. Reference.

628. A firm in the Dominican Republic wishes to buy a two-mast schooner in good condition, of about 100 to 150 tons gross registry, and suitable for the coastwise trade of that country. Payment will be made by cash, on delivery, in the United States. Correspondence may be in English. References.

629. A man in France desires to buy hardware, electric apparatus, agricultural machinery, greases, new products for factory consumption, etc. He also wishes to entertain an agency proposition. Correspondence should be in French. References.

630. A firm in the United States which is representing a firm in Spain is in the market for complete equipment for a factory to manufacture locomotives, and would like to receive quotations on such. References.

631. A firm in Cuba wishes to be placed in communication with American manufacturers and exporters of modern machinery for making vermicelli of all kinds.

632. A firm in India wishes to buy or secure an agency, on commission basis, for the sale of razors, slates, lead pencils, suspenders, garters, spoons, cutlery, safety pins, hair pins, aluminum ware, steel pens, etc. Payment will be made in 60 days or cash against documents at destination. Correspondence may be in English. Reference.

633. A manufacturing firm in France desires to receive catalogues from American manufacturers and exporters of shoes and shoe supplies, with a view to representing them, primarily, and also for outright purchases. Correspondence may be in English, but French is preferred. Reference.

634. A company in Switzerland is in the market for lumber and wood specialties, such as pitch pine, yellow pine, Oregon pine, clear silver spruce, whitewood, cottonwood, hickory, walnut, butternut, birch, oak, ash, mahogany, polisander, cedar, gayac, padono, and others, for making railway-car floors, aeroplanes, cigar boxes, gunstocks, etc. Cash will be paid. If possible, the company will charter a sailing vessel for transportation of purchases. Correspondence may be in English. References.

635. A man in France desires to represent, on a commission basis, American manufacturers and exporters of enameled kitchen ware and glass lighting fixtures for electric and gas lamps. Catalogues and full information should be submitted. He also desires to purchase goods for his own establishment. Correspondence should be in French. References.

636. An agency, on commission, is desired by a firm in Brazil for the sale of dry goods, shelf and builders' hardware, glassware, procelain, earthenware, canned goods, drugs and chemicals, boot-and-shoe upper leathers and findings, typewriters, and office equipment and supplies. Quotations should be made f.o.b. New York. Payment will be made by cash against documents for initial trading, to be later modified at discretion of American firms. Correspondence should be in Spanish.

637. A man in Venezuela is in the market for a small and inexpensive machine for making wire nails. Payment will be made by cash before shipment, in American currency. Correspondence may be in English. Reference.

638. A wholesale commission merchant in Spain wishes to represent American manufacturers and exporters of silver articles, such as vases, fruit dishes, centerpieces, dishes, table flat ware, etc. Correspondence should be in Spanish or French. References.

639. An agency is desired by a man in Spain for the sale of moderate-priced automobiles which could retail in Spain at from $1,200 to $1,400. He wishes to sell on a commission basis. Correspondence should be in Spanish or French. References.

640. A merchant in Newfoundland wishes to purchase haberdashery used in the tailoring business, such as buckles, buttons, pants hooks and eyes, rubber protectors, rubber tissue, etc. Quotation should be made f.o.b. New York. Payment will be made by cash against documents. Goods should be packed in iron-bound wooden cases. Reference.

641. A wholesale and retail dealer in Spain desires to buy and secure the exclusive right for the sale of illustrated postal cards in that country. Payment will be made against documents at destination. Correspondence should be in French or Spanish. References.

642. A firm in the United States which is representing a firm in Spain is in the market for imitation leather for bags, low-priced adding machines, rubbers, and overshoes. Reference.

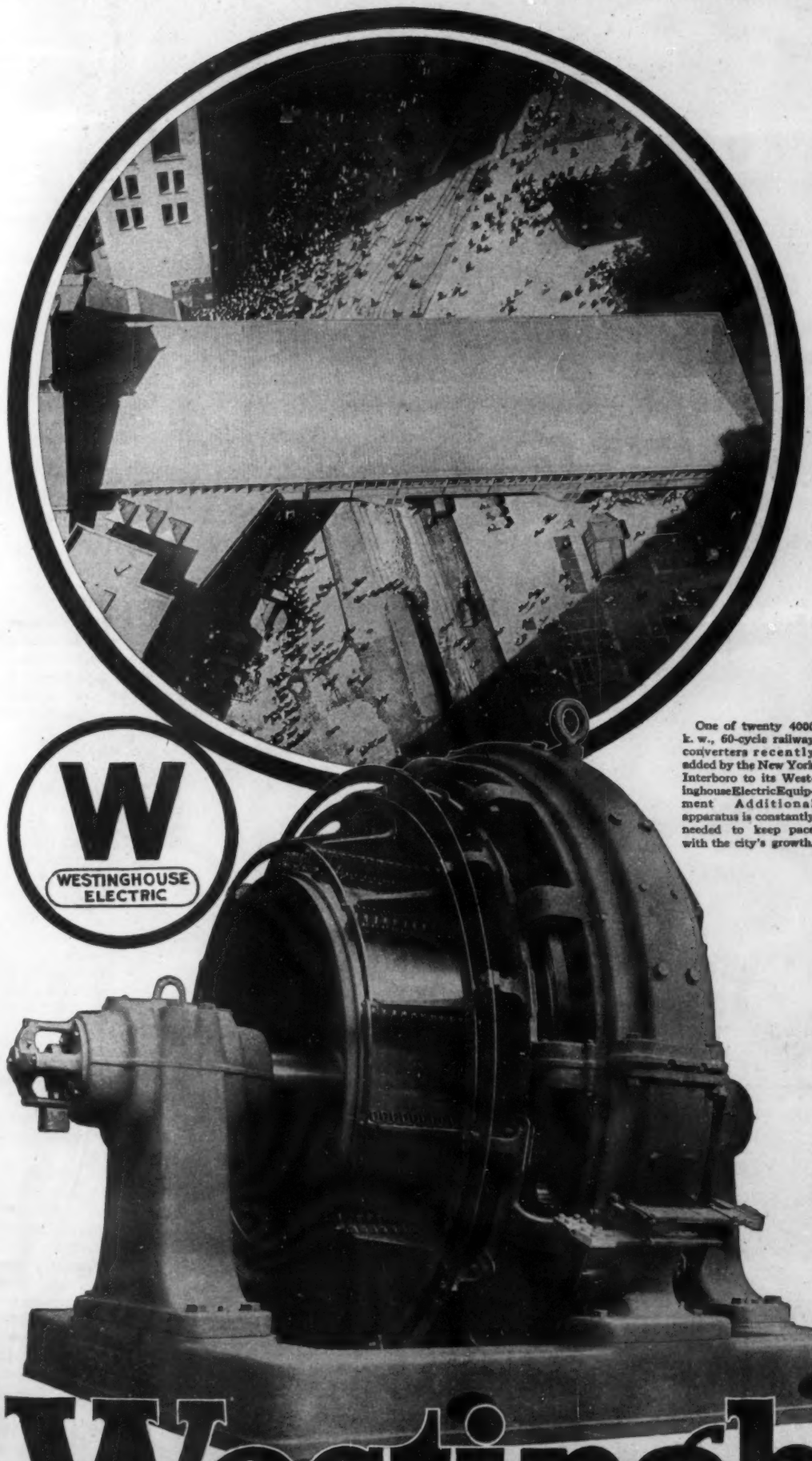
643. A business man in New Zealand is in the market for galvanized corrugated iron and plain galvanized iron, 24, 26, and 28 gage. Quotations may be made f. o. b. steamer at port of shipment. Payment will be made by sight draft through Bank of New Zealand. References.

644.—A correspondent in Transvaal, South Africa, wishes to represent American manufacturers and importers hardware, woodworking and agricultural machinery, in the Transvaal and Free State.

645.—A man from the Netherlands who has opened a branch office in the United States and who will be there personally for a period of about three months, is in the market for technical articles, such as automobiles, motorcycles, boat-motors, and all parts and accessories thereof, electro-technical articles, labor-saving devices, etc. References.

646.—A company employed by the Government of Brazil desires to purchase electrical supplies for the upkeep of large lighting and street-car system. Quotations should be made f. o. b. New York. Payment will be made by cash against documents. Correspondence may be in English. Full information in regard to terms, prices of electrical supplies, etc., should be submitted at once.

How New Yorkers Get to Work



One of twenty 4000 k. w., 60-cycle railway converters recently added by the New York Interboro to its Westinghouse Electric Equipment. Additional apparatus is constantly needed to keep pace with the city's growth.

Here at the heart of the world's metropolis one of the world's greatest transportation problems has been solved by electricity.

By its help hundreds of thousands of workers are brought from far and wide and packed daily within the confines of a narrow island.

And again at night-fall they are spirited away, and the deep canons of the down-town streets are deserted.

The city's rush has left all other motive power helplessly out-distanced. Vehicles drawn by horses or operated by steam power are things of a by-gone generation.

New York as it is today would be unthinkable except for the great turbo-generators in power stations, and the myriad electric motors driving railway locomotives, subway and elevated trains and surface cars, and the thousands of electrically equipped automobiles.

With this great development Westinghouse Electric engineering has gone hand in hand. Constant improvement in Westinghouse motors and controllers, bigger and bigger Westinghouse turbo-generator units, transformers and railway converters, more and better Westinghouse safety-devices have kept pace with the unparalleled growth of the biggest of cities.

And today, as from the earliest electrical beginnings, Westinghouse anticipates the greater throng of workers yet to come.

Even now, in Westinghouse shops, generating units of greater capacity, greater man-transporting power, are being built to meet the demand that New York will make upon electricity in the months to come.

And do not forget that this is the same Westinghouse Electric whose name is the stamp of quality on your electric range, toaster, and electric iron, the starting motor and generator on your automobile and hundreds of other devices that help to make electricity your daily servant.

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East Pittsburgh, Pa.

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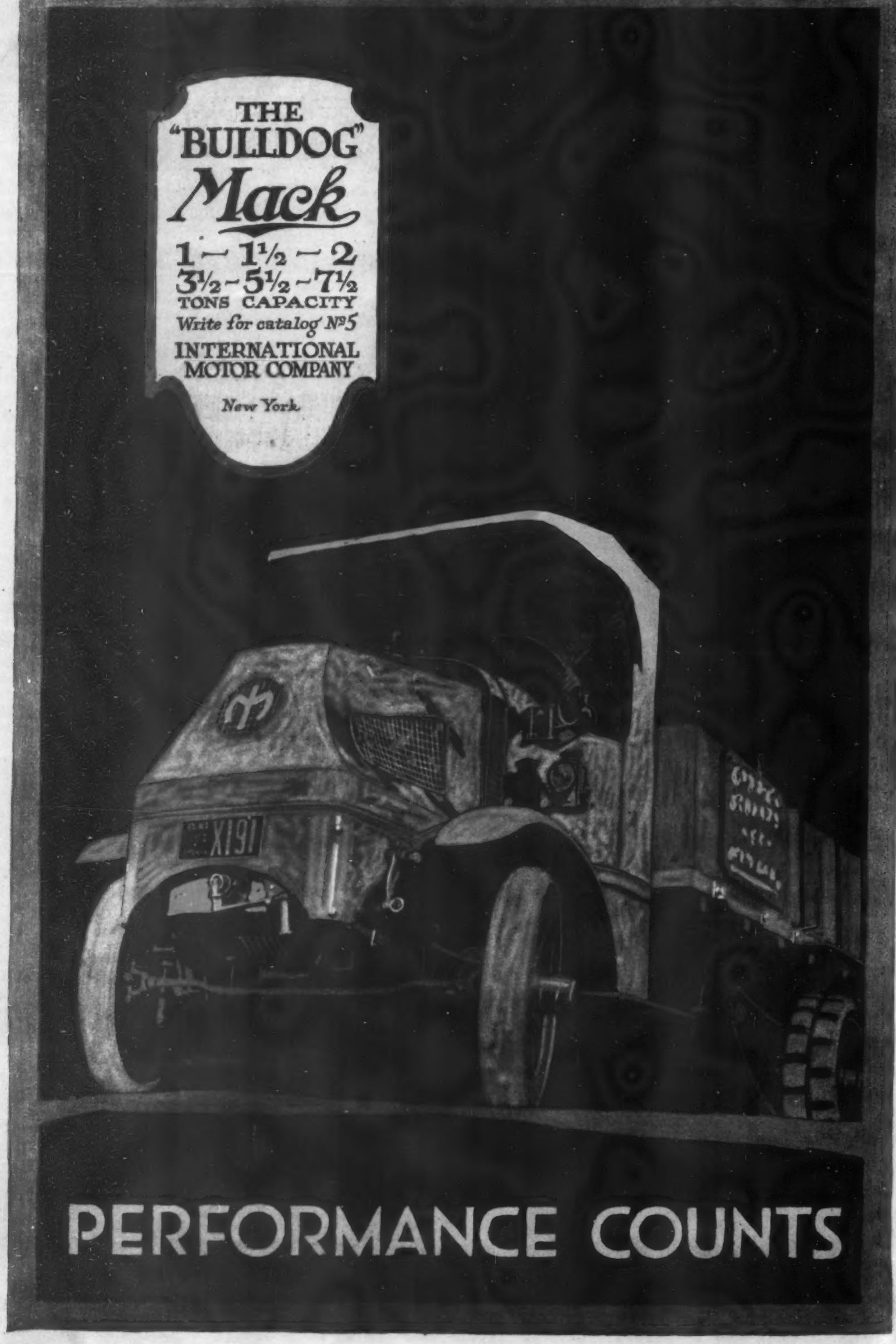

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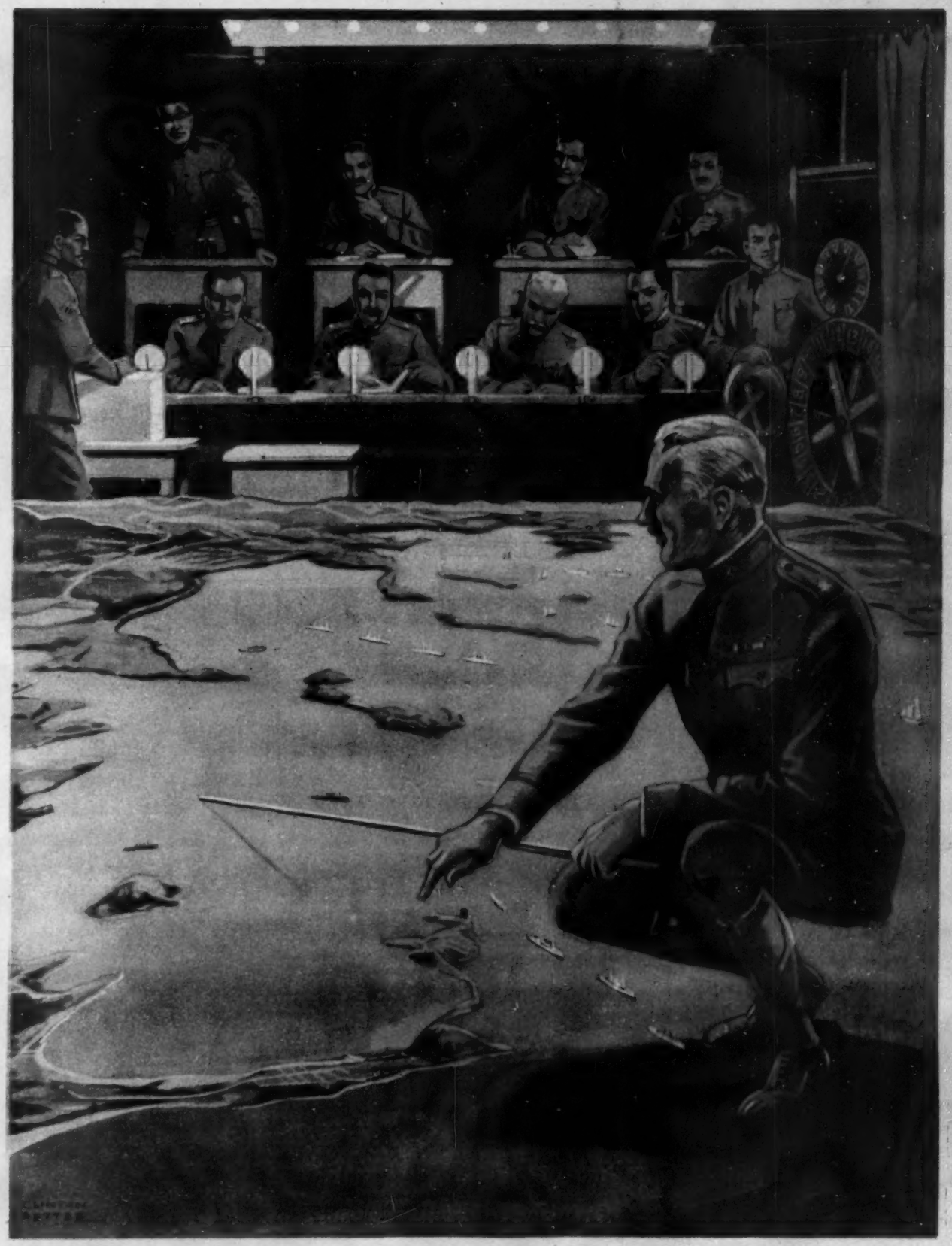

OUR COAST ARTILLERY OFFICERS PLAYING THE GAME OF WAR ON A LARGE SCALE RELIEF MAP—[See page 161]

September 1, 1917

Munn & Co., Inc., Publishers
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THE TASK NOW CONFRONTING AMERICAN BUSINESS

TO meet the gigantic demands of a world war upon our industrial resources, with the flower of our man power diverted to military service. To produce and transport more million tons with fewer million men. As President Wilson has pointed out: "It must be evident to every thinking man that our industries, on the farms, in the shipyards, in the mines, in the factories, must be made more prolific and more efficient than ever."

These industries stimulate all other lines of business. There is more activity—more money is spent—than would be possible in ordinary times.

But how can reduced man power be made more productive? By the use of more machinery and better machinery and by a more concentrated use of the equipment in hand. What is true of production is equally true of transportation. It is idle to produce if you cannot transport.

HIGH GRADE TRUCKS MUST REPLACE HORSES

Doing the work of three or four teams and their drivers, one truck would save 75% of the man power. One good truck which does the work of two poor ones will increase this saving. Each unit will be taxed to the limit to save time and men. The truck which is not designed to stand up under high pressure operation, day in and day out, season after season, will fail in the most vital respect—*constant performance.* Time out of service will be extremely expensive.

Even under ordinary conditions, the grinding, straining and pounding of truck service renders the best mechanism the most economical at whatever price. Under the extraordinary conditions before us *none other will take care of the traffic.*

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For years it has been the White policy to build only the best. There is no short cut to efficiency and endurance in a truck. Only the pick of material and the most refined construction will produce the White standard of service. The White truck has always been more economical than any cheaper make. In high pressure operation this superiority becomes something more important than economy; it means more days in active service—*a much greater volume of performance.*

The largest users of motor trucks in this country recognize the White value. They buy it in fleets and add to these fleets year after year, based upon experience. They know the real value of a motor truck. Their cost records tell the story.

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Trucks That Follow the Sign of Good Service Take Less Time Out

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The sturdy, unscarred tread shows little evidence of the wear and tear of hauling capacity loads over rough roads.

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